Social networks, social support, and contextual factors that affect blood glucose control among individuals with type 2 diabetes mellitus in urban Ghana

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DEDICATION

In loving memory of my father, T.A. B., who sparked my research interests in diabetes. And to my mother, A. M. B. for her unwavering support, love, and prayers. I love you and thank you.

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ABSTRACT

This study used primary data from Kumasi, Ghana, to examine whether social networks, social support, diabetes-related stigma, religion, and traditional medicine affected blood glucose (HbA1c) control among adults with type 2 diabetes mellitus (T2DM). First, the study evaluated whether three social network characteristics (kin composition, household composition, and network density) were directly or indirectly (via social support) associated with HbA1c. Kin composition and household composition were significantly associated with social support. Neither network characteristics nor social support were associated with HbA1c, which suggests that social network characteristics may operate through mechanisms other than social support to affect HbA1c among study participants. Secondly, the study examined whether self-, perceived, or enacted stigma moderated associations between social network characteristics (network size, kin composition, household composition, and network density), social support, and HbA1c. Among study participants reporting low self-stigma, kin composition was positively associated with social support, but this association was not found among those reporting moderate self-stigma. Finally, the study assessed whether the frequency of participation in religious activities and the use of traditional medicine practitioners were associated with HbA1c control. Increased participation in religious activities was associated with decreased HbA1c, which suggests that religious activity may play a beneficial role in T2DM management among Ghanaians who identify as religious. Overall, this study provides important insights about the roles of social

networks in T2DM management among Ghanaians, the detrimental effects of stigma on the social support that emanates from those social networks, and the influence of religion and traditional medicine on HbA1c control.

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LIST OF ABBREVIATIONS

HIC..... High-income country

IDF .....International Diabetes Federation

JSS.....Junior secondary school

LMIC.....Low- and middle-income country

SSS..... Senior secondary school

T1DM..... Type 1 diabetes mellitus

T2D ..... Type 2 diabetes

T2DM..... Type 2 diabetes mellitus

TM.....Traditional Medicine

CHAPTER 1

INTRODUCTION

The prevalence of type 2 diabetes mellitus (T2DM) is growing faster in low- and middle-income countries (LMICs) compared to high-income countries (HICs), and the accompanying demands of disease management often place an additional burden on weak health systems in LMIC settings (WHO, 2011, 2016). Many countries have national diabetes policies to address disease management, but resources for strategic policy implementation are scarce (WHO, 2016).

Ghana has experienced a steady but significant increase in the number of T2DM cases, complications, and deaths within the past 31 years (Sarfo-Kantanka et al., 2016). This increasing prevalence of T2DM is worrisome because of the limitations in health infrastructure and government resources that place nearly all the responsibility for disease management on affected individuals, their families, friends, and communities (de-Graft Aikins et al., 2010). While Ghana's National Health Insurance Scheme may offset the costs for certain diabetes medicines and laboratory tests, those with T2DM can still have high treatment expenses, especially when disease complications arise (de-Graft Aikins, Awuah, Pera, Mendez, & Ogedegbe, 2015; Quaye, Amporful, Akweongo, & Aikins, 2015). In some instances, the dependence on family members results in strained relationships because of limited financial resources and the inability to provide continuous support for affected individuals (Aboderin, 2004; A. D.-G. Aikins, 2004;

Tagoe, 2012). When financial resources are scarce, some individuals with T2DM resort to traditional medicine (TM), particularly because of beliefs that chronic diseases, like diabetes, may be caused by spiritual forces (Atobrah, 2012; A. de-Graft Aikins, 2005). Church activities and prayer have also been described as coping mechanisms for those with diabetes in Ghana (de-Graft Aikins, 2006; A. de-Graft Aikins, 2005), but there is lack of evidence showing how TM or religious practices are related to blood glucose (HbA1c) control. Furthermore, in rural Ghana, the emerging issue of diabetes-related stigma as a potentially pervasive psychosocial challenge increases the risk of losing of social support, alters social interactions, and adds to the already complex challenge of managing a chronic disease in a poor-resource setting (de-Graft Aikins, 2006). However, in this setting, the effect of stigma on HbA1c control has not yet been evaluated.

An extensive body of evidence, mainly from HICs, provides some key findings about the links between social relationships and T2DM management. First, existing relationships with family members, friends, and others in one's social networks are the channels through which social support is often obtained to enable T2DM management and HbA1c control (Brinkhues et al., 2018; Vaccaro, Exebio, Zarini, & Huffman, 2014). As a functional dimension of social networks, social support, which generally refers to the assistance that one can receive or has previously received from other individuals, is distinct from compositional and structural dimensions of networks (Ashida & Heaney, 2008). Increased social support is directly associated with reduced HbA1c, but it is also indirectly associated with HbA1c through various mechanisms including diet and medication adherence (Gao et al., 2013; Stopford, Winkley, & Ismail, 2013). Previous studies suggest that kin composition, household composition, and network density are

important compositional and structural dimensions of social networks that shape health outcomes for individuals with T2DM through the influence of health-related behaviors. (Knutsen et al., 2017; Patel et al., 2017; Reeves et al., 2014). However, there is little evidence regarding the associations between these network characteristics and HbA1c. Secondly, the effects of these network characteristics and social support on T2DM may differ for men and women (Mondesir, White, Liese, & McLain, 2016). Thirdly, diabetes-related stigma, which occurs within the sphere of social relationships, is associated with psychological distress, lower social support, social isolation, and poor disease management with potentially negative consequences for the well-being of those with T2DM (Gredig & Bartelsen-Raemy, 2017; Schabert, Browne, Mosely, & Speight, 2013; Tak-Ying Shiu, Kwan, & Wong, 2003). Fourthly, increased frequency of religious practices improves T2DM management and increases social support, both of which facilitate HbA1c control (Namageyo-Funa, Muilenburg, & Wilson, 2015; Newlin, Melkus, Tappen, Chyun, & Koenig, 2008). Furthermore, social support has been identified as a potential mediator of the links between religion and health outcomes (George, Ellison, & Larson, 2002; Namageyo-Funa et al., 2015; Newlin et al., 2008), but relationships among religion, social support and HbA1c control have hardly been explored. Taken together, existing findings demonstrate that social networks, social support, gender, stigma, and religion can shape the well-being of individuals with T2DM in HICs.

In spite of this rich body of work, there are gaps in knowledge that limit the creation of T2DM intervention strategies, especially in LMICs where diabetes-specific research has been limited. For example, mechanisms through which social network characteristics

affect HbA1c are unclear, so there is minimal understanding of the types of networks that are useful for people with T2DM. Research investigating whether social network characteristics affect T2D outcomes through social support is scarce. Most studies have either examined social networks and HbA1c or social support and HbA1c but have rarely looked at all three factors simultaneously. Thus, the body of T2DM research can expand and concurrently address the distinct but related contributions of social network characteristics and social support for disease management. Findings from such research endeavors will provide evidence for the development of relevant and practical T2DM management strategies, particularly in a place like Ghana. Additionally, very little is known about associations between religious participation and HbA1c control in Ghana or how diabetes-related stigma, social support, and HbA1c may be related, even though lower levels of stigma and increased religiosity are both associated with higher social support and lower HbA1c among those with T2DM in HICs (Gredig & Bartelsen-Raemy, 2017; Krause & Wulff, 2005; Liu et al., 2017; Newlin et al., 2008). Furthermore, individuals with T2DM in Ghana use traditional medicine (TM) for disease management, and some family members provide support by seeking TM approaches on behalf of relatives with chronic disease conditions (Atinga, Yarney, & Gavu, 2018; Atobrah, 2012; A. de-Graft Aikins, 2005), but findings on the links between TM use and HbA1c control are scarce. These limitations indicate a need for further research to deepen the current understanding about social relationships, contextual factors, and their relevance for HbA1c control within an LMIC setting where diabetes is an emerging public health concern.

This research adopted a social network approach to examine various aspects of social relationships that can influence HbA1c and to also identify the effects of contextual dimensions of diabetes management that go beyond individual and clinical factors. Using Berkman and colleagues' (2000) conceptualization of the ways in which social networks impact health, this research identified whether social networks operate through social support to affect HbA1c control among Ghanaians with T2DM while accounting for the roles that gender and diabetes-related stigma may play in potentially altering social network mechanisms. Additionally, this research evaluated religious participation and the use of TM practices, as well as the independent association of these factors with HbA1c control. The research aims and hypotheses are as follows:

Specific Aim 1: To examine relationships between social network characteristics (kin composition, household composition and network density) and HbA1c among adults with T2DM in Kumasi, Ghana.

Hypotheses

H1a. Social network characteristics (higher kin composition, higher household composition and higher network density) will be associated with decreased HbA1c.

H1b. The relationships between social network characteristics (kin composition, household composition and network density) and HbA1c will be mediated by perceived diabetes social support, such that those with higher social support will have decreased HbA1c.

Specific Aim 2: To examine how gender and stigma modify the relationships between social network characteristics (kin composition, household composition and network density) and HbA1c among adults with T2DM in Kumasi, Ghana.

Hypotheses

H2a. The relationships between social network characteristics (kin composition, household composition and network density) and perceived diabetes social support will be moderated by diabetes-specific stigma, such that that those with higher stigma levels will have less social support and increased HbA1c.

H2b. The direct effect of social network characteristics (kin composition, household composition and network density) on HbA1c will differ between men and women.

H2c. The indirect effect of social network characteristics (kin composition, household composition and network density) on HbA1c, via perceived diabetes social support, will differ between men and women.

Specific Aim 3: To examine the effects of religious participation and TM on perceived diabetes social support and HbA1c among adults with T2DM in Kumasi, Ghana.

Hypotheses

H3a. Increased religious participation will be associated with decreased HbA1c.

H3b. The relationship between religious participation and HbA1c will be mediated by social support such that those with higher social support will have decreased HbA1c.

H3c. Increased use of TM will be associated with increased HbA1c.

The research contributes to public health and social science knowledge in three main ways. Firstly, by concurrently examining compositional, structural, and functional dimensions of social networks, this research has demonstrated whether social network characteristics, social support and HbA1c are linked to each other among individuals with

T2DM in an LMIC context. Secondly, this research broadens current knowledge about the prevalence of diabetes-related stigma in an LMIC context through a comprehensive measure of this important psychosocial factor and identifies how it may shape access to social support and HbA1c. Finally, the research expands our awareness of the relevance of religious participation for HbA1c control and indicates the links between the use of TM practices and HbA1c. Overall, findings provide a better understanding of which aspects of social relationships are beneficial for health outcomes among people with T2DM in countries, like Ghana, and an indication of contextual factors that may be worth examining in future interventions to improve T2DM outcomes.

The remainder of the dissertation is organized into four chapters, which focus on a review of the literature on social networks and social support, as well as important gender differences, diabetes-related stigma, religious participation, and TM (Chapter 2); the research design and methods used for this study (Chapter 3); research findings that are presented in three manuscripts (Chapter 4); and the implications of this study's findings, particularly in an LMIC context (Chapter 5).

CHAPTER 2

BACKGROUND AND SIGNIFICANCE

This chapter begins with a brief description of the prevalence of diabetes in Africa and in Ghana. It also describes Ghana's health landscape with respect to T2DM. Next, the literature on social networks, social support, and T2DM is presented, demonstrating the need for additional T2DM research in the context of LMICs. Findings on diabetes-related stigma are also presented with respect to how stigma may influence social networks and access to social support for diabetes management. Additionally, religion and traditional medicine are discussed as important sociocultural factors that shape health and well-being in Ghana, with potential effects on HbA1c control. The chapter concludes with a summary of the literature, gaps in knowledge, and the goals and hypotheses for the dissertation research.

2.1 A brief review of type 2 diabetes mellitus (T2DM)

Globally, T2DM has become one of the most expensive chronic diseases and is increasingly prevalent in LMICs (Bazargani, Boer, Leufkens, & Mantel-Teeuwisse, 2014; Khandelwal, 2013; Seuring, Archangelidi, & Suhrcke, 2015). Disease complications, comorbidities, and the high demands of disease management are often linked to psychosocial issues including depression and anxiety (Ducat, Philipson, & Anderson, 2014; Karuranga & Duke, 2018; Lin et al., 2010). Despite the high disease burden in LMICs, the majority of T2DM research derives from HICs (Afable &

Karingula, 2016). The International Diabetes Federation (IDF) reported that Africa had the highest burden of undiagnosed T2DM cases worldwide in 2015 (International Diabetes Federation, 2016b). In 2017, 516 million African adults had diabetes (International Diabetes Federation, 2017). Lack of diabetes education, limited knowledge about diabetes screening, and loopholes in disease surveillance are some of the reasons for the high prevalence of undiagnosed diabetes cases on the continent (Assah & Mbanya, 2017). Options for biomedical management of diabetes and many other chronic diseases are limited because of the additional strain that chronic diseases have placed on weak health systems within the continent (WHO, 2011).

2.2 T2DM in Ghana and factors that may affect disease management and outcomes

Ghana has experienced a significant increase in T2DM hospital admissions, complications, and deaths within the past 31 years (Sarfo-Kantanka et al., 2016). In 2013, at least 440,000 Ghanaian adults between the ages of 20 and 79 had T2DM, and it is estimated that this number will rise to 819,000 by 2035 (Guariguata et al., 2014). T2DM has consistently remained among the country's top ten causes of morbidity and mortality within the last decade (Amoah, Owusu, & Adjei, 2002). Country-specific research with a predominant focus on two large urban cities has shown that the prevalence of T2DM increased from less than 1% to nearly 10% between the 1950s and 2012 (Danquah et al., 2012; A. de-Graft Aikins, Agyei-Mensah, & Agyemang, 2014). A recent systematic review indicated that the overall prevalence was 6.46% (Asamoah-Boaheng, Sarfo-Kantanka, Tuffour, Eghan, & Mbanya, 2018). Diabetes appears to be more prevalent in urban areas of the country (Agyei-Mensah & de-Graft Aikins, 2010; Amoah et al., 2002; International Diabetes Federation, n.d.-a). However, uncontrolled and undiagnosed

diabetes, especially among rural residents, have also been documented through previous research (Cook-Huynh et al., 2012). This implies that actual prevalence rates in Ghana may be higher than the current estimates.

Understanding the characteristics of individuals with T2DM, based on the current body of evidence in Ghana, may be helpful in developing disease management strategies for blood glucose (HbA1c) control. At least two studies have found that Ghanaians with T2DM are more likely to be male, middle-aged, and older (A. de-Graft Aikins et al., 2014; Gatimu, Milimo, & Sebastian, 2016). These individuals often have hypertension or another chronic disease (Mogre, Abedandi, & Salifu, 2014). A study of T2DM patterns among Ghanaians living in Ghana and Europe indicated that increasing T2DM prevalence was associated with lower levels of education among urban Ghanaian men (Addo et al., 2017). However, higher T2DM prevalence was associated with increasing levels of education among rural Ghanaians irrespective of gender (Addo et al., 2017). These mixed findings indicate the need to further examine links between education and diabetes within this population. Previous work has suggested that low socioeconomic status is associated with a poor quality of life among people with T2DM in Ghana (de-Graft Aikins, Awuah, Pera, Mendez, & Ogedegbe, 2015; Osei-Yeboah et al., 2016). These characteristics provide some direction for potential intervention strategies; however, more research is required to further understand the contexts within which those strategies might work best.

The high cost of T2DM treatment in Ghana also has implications for disease management strategies and is linked to two main issues. First, the funding for chronic disease programming in Ghana is relatively minimal in comparison to resources often

allocated to infectious diseases (Bosu, 2012). Thus, existing government subsidies may be insufficient in reducing out-of-pocket costs for most people with T2DM. For example, Ghana's National Health Insurance Scheme includes the provision of certain diabetes medicines and specific laboratory tests (de-Graft Aikins et al., 2015). However, the scheme's annual premium costs, as well as the delay in drug procurement, disproportionately impact the poor in rural and urban settings who may have higher financial instability compared to others (de-Graft Aikins et al., 2014). Some Ghanaians with T2DM have reported that they ignored medical treatment advice because of limited financial resources (de-Graft Aikins et al., 2015). This behavior may adversely affect their ability to biomedically manage T2DM and may potentially lead to poorer health outcomes.

Secondly, diabetes complications in Ghana, which include fatigue, foot infections, blindness, and sexual dysfunction (Asumanu, Ametepi, & Koney, 2010; de-Graft Aikins et al., 2014), are often accompanied by high treatment costs. A cost analysis conducted at four clinics in Ghana revealed that the expenses among T2DM patients with complications were more than double the expenses for patients without complications (Quaye, Amporful, Akweongo, & Aikins, 2015). The late detection and diagnosis of diabetes, which increased the likelihood of patients developing complications by the time they sought medical treatment, was linked to the higher costs for disease management (Quaye et al., 2015). These findings about the financial burden of T2DM in Ghana suggest that earlier disease detection could be beneficial in mitigating health challenges that arise from disease complications and could potentially reduce the physical, mental, and economic challenges that affected individuals may face. Bosu (2012) has suggested

that the lack of functional chronic disease policies in Ghana may have delayed a comprehensive governmental approach to the increasing burden of diabetes and other chronic diseases. This delay may also be a reflection of the country's fragile heath system at large. Thus, it may be important to look beyond government assistance and examine the social networks upon which Ghanaians with T2DM may rely and that may affect disease management and outcomes like HbA1c.

2.3 The role of social networks in T2DM

A social network refers to the ties among people or organizations as well as the pattern of relationships that emerges from those ties (Valente, 2010). These networks can enable the spread of behaviors, attitudes and resources among members (Perkins, Subramanian, & Christakis, 2015). In egocentric network studies, which often focus on the types, characteristics, and structure of these relationships, an individual (ego) provides information on people (alters) within his or her network without researchers having any interaction with the alters (Smith & Christakis, 2008). In comparison to sociocentric networks that typically focus on bounded groups (Perkins et al., 2015), egocentric network research is an inexpensive approach for quickly learning about the nature of individuals' networks and how they may be relevant for various outcomes.

There is a strong evidence base for the association of social networks with the management and control of T2DM, primarily from HICs (Kaplan & Hartwell, 1987; Miller & DiMatteo, 2013; Mondesir, White, Liese, & McLain, 2016; Strom & Egede, 2012; Vaccaro, Exebio, Zarini, & Huffman, 2014). T2DM management often requires resource mobilization from one's social networks (Vassilev et al., 2011). This is because

most T2DM management behaviors related to food, exercise, and medication adherence occur outside of a clinical environment and within a family setting or the larger community (Fisher et al., 1998; Knutsen et al., 2017). For instance, food practices are often shaped by the preferences and capacity of household and/or family members and inevitably require cooperation and collaboration with these individuals to control HbA1c (Abdulrehman, Woith, Jenkins, Kossman, & Hunter, 2016; Ciechanowski, Katon, & Russo, 2005; Fisher et al., 1998). Previous studies have suggested that kin composition, household composition, and network density are aspects of social relationships that are critical for T2DM management and control (Knutsen et al., 2017; Patel et al., 2017; Reeves et al., 2014). These findings imply that the proportion of family and household members within one's network, as well as the interconnectivity among network members, should be considered in evaluating HbA1c control.

Kin composition, general health outcomes and T2DM.

Relatively little research has been conducted on the influence of kin composition on diabetes-related outcomes like HbA1c, even within HICs. Findings from two studies indicate that a higher proportion of kin within adults' social networks is associated with the adoption of positive, chronic disease-related behaviors, such as reduced salt intake, and lower psychological distress (Levy-Storms & Lubben, 2006; Peek & Lin, 1999). At least two studies have also found that family members are instrumental in facilitating self-management behaviors that are necessary for HbA1c control (Miller & DiMatteo, 2013; Vaccaro et al., 2014). There is evidence that in comparison to supportive and ambivalent friends, having a greater number of supportive family members within one's network is a significant predictor of lower, high-sensitivity C-reactive protein, which is a

biomarker for the risk of cardiovascular disease, diabetes, and cancer (Uchino et al., 2015). Other studies have revealed that family members can hinder or facilitate the health of individuals with T2DM, particularly with respect to discussions and negotiations around food choice and consumption, as well as the adoption of dietary patterns (Denham, Manoogian, & Schuster, 2007; Knutsen et al., 2017; Wong, Gucciardi, Li, & Grace, 2005). Consequently, one's family can create and sustain the "practical, social, and emotional context" that shapes one's ability to achieve health-related goals (Rosland & Piette, 2010, p. 3). Many social network studies with a T2DM focus have examined self-reported diabetes management behaviors as the outcome, with little attention being given to biomedical outcomes like HbA1c. Investigating the associations between kin composition and HbA1c will increase knowledge about the role that kin-based networks play in enabling the health of people with T2DM.

Household composition, general health outcomes and T2DM.

Household composition, which refers to the proportion of network members with whom one lives, may be another important factor for HbA1c control. Households provide a potentially important platform for chronic disease interventions because of genetic, environmental, and interpersonal factors that often link household members (Patel et al., 2017), but related research findings are limited. Studies on household composition and health in both HICs and LMICs indicate that the person who cooks for an individual with T2DM must be knowledgeable about his or her dietary needs, willing to make the necessary changes, or have the capacity to adapt existing food practices within the home (Abdulrehman et al., 2016; Iregbu & Iregbu, 2016). Additionally, meal preparation by household members and the family's financial ability to regularly obtain healthy food

options are among factors that affect T2DM management (BeLue et al., 2012). These findings point to supportive roles that household members can play in enabling dietary adherence among individuals with T2DM. Within the households of individuals with chronic diseases, the presence of middle-aged, female household members who are not their spouses is also beneficial for improved health outcomes and has been significantly associated with a reduced risk of chronic diseases (Mudrazija, López-Ortega, Vega, Robledo, & Sribney, 2016). While these studies suggest that at the household level, the potential contributions of adult, female caregivers and meal preparers could be crucial for HbA1c control, further research can elucidate the contexts within such caregivers may be needed for enabling T2DM management for different types of individuals.

There are at least two ways through which household members can worsen or increase the risk of adverse health outcomes. First, in a multinational study with over 7000 individuals with T2DM from 17 countries, participants who lived with other adults, but not their respective partners, had significantly higher diabetes distress and lower well-being when compared to study participants who lived with a partner or had other variations in household composition (Joensen et al., 2017). This outcome was perceived as the result of higher relationship strains that are experienced when living with other adults, such as one's parent or an adult child (Joensen et al., 2017). Secondly, an Indian study that examined several chronic conditions, including diabetes, found that living with a person who has a chronic disease, irrespective of genetic and kinship ties, increased one's risk of developing a chronic disease (Patel et al., 2017). These two studies did not investigate whether living with someone who had T2DM may worsen or improve one's own HbA1c control. However, they provide evidence that household contributions to

health outcomes may be distinct but just as important as family effects on health outcomes. Taken together, findings from these studies imply that household members may shape one's well-being. The studies also suggest that gender, age, disease state of household members, and the nature of relationships between people with T2DM and their respective household members are factors that may influence diabetes management.

Network density, general health outcomes and T2DM.

The research on network density and health outcomes has varied both in context and scope, and there has been little consistency in the findings. Density refers to the degree to which alters in the network know each other (Burchinal, Follmer, & Bryant, 1996). A dense network suggests that alters are highly connected to each other, whereas a non-dense network contains alters that have few, if any, connections to one another (Bear, 1990). The wider literature suggests that dense networks can yield both positive and negative outcomes. For example, dense networks can enable emotional stability, especially when there are positive and intimate connections (Acock & Hurlbert, 1993; Lee, Chung, & Park, 2016). Dense networks have also been associated with improved mental and physical health outcomes, decreased risk of mistreatment among older adults, and improved well-being among college students (Benson, 2012; Lee et al., 2016; Luke & Harris, 2007; Schafer & Koltai, 2015). However, dense networks can increase needle sharing among drug users, overwhelm individuals with too much information during stressful situations, and reduce access to distinct resources (Cornwell, 2009; Latkin et al., 1995; Taylor, 2006). These studies show that evidence for the role of density in health outcomes is inconclusive; hence, additional research is needed to delineate the types of health issues and audiences for whom a dense network may be beneficial.

Although density is perceived as an important aspect of social networks (Lee et al., 2016; Schafer & Koltai, 2015), there is a paucity of research examining this network characteristic with respect to T2DM. In a U.K. study on individuals with diabetes and/or chronic heart disease, the ability to manage one's disease(s) was significantly associated with having a less dense network (Reeves et al., 2014). Little explanation was provided for this finding, but it is possible that less dense networks provided an opportunity for study participants to discuss health matters and seek potentially varied resources from people who did not know each other without fear of information being shared among network members. The study did not look at outcome measures such as HbA1c, so it is unclear whether the associations between network density and chronic disease management are distinct from associations between network density and chronic disease outcomes. Expanding this line of research by investigating how network density is linked to HbA1c may potentially yield meaningful recommendations regarding the types of networks that facilitate T2DM outcomes.

2.4 Gender differences in social network characteristics, health outcomes and T2DM

Some studies have provided evidence regarding gender differences in social network characteristics and health outcomes, although the main focus in these studies has been on network size as the characteristic of interest (Fischer & Oliker, 1983; Kaplan & Hartwell, 1987; Levy-Storms & Lubben, 2006). Previous work on social network characteristics and T2DM has largely neglected the analysis and discussion of gender effects (Spencer-Bonilla et al., 2017; Vassilev et al., 2011). To date, only one study appears to have examined gender differences in social network size and the effects on glucose levels and T2DM symptoms (Kaplan & Hartwell, 1987). Findings revealed that

large networks were associated with increased HbA1c among men, but those trends were not observed in women (Kaplan & Hartwell, 1987). The broader literature provides some important findings from which inferences about kin composition and network density can be made with respect to T2DM outcomes. For instance, women in HICs are more likely to have social networks with larger proportions of kin in comparison to men (Moore, 1990). Also, denser networks, as measured by emotional closeness to alters and relationship duration with alters, indirectly affects depressive symptoms through social support for women but not men (Haines et al., 2008). These studies suggest that when compared to men, women may be embedded in more kin-focused networks and that they may gain more health advantages from denser networks. Although it is possible that the same findings may be reflected among people with T2DM in Ghana, more research is imperative for critically examining these links.

2.5 Social networks research in LMICS and Ghana

Existing research on social networks and T2DM has mainly occurred in HICs (Spencer-Bonilla et al., 2017; Vassilev et al., 2011). Currently, there is limited knowledge of how social networks may impact T2MD management and control, particularly in LMICs that have observed an increasing diabetes prevalence (Atun et al., 2017; Dagenais et al., 2016; Gill, 2014; Guariguata et al., 2014; Mbanya, Motala, Sobngwi, Assah, & Enoru, 2010). Research suggests that the care and well-being of chronically ill individuals, like those with T2DM, often become the responsibility of the affected individuals and their family members, households and other personal support systems because of the inadequate health system infrastructure and limited government financing in many African countries (de-Graft Aikins, 2005; de-Graft Aikins et al., 2010; Evans,

2010; Westaway, Seager, Rheeder, & Van Zyl, 2005). Compared to individuals with T2DM in HICs that often have a strong health infrastructure (Bitton et al., 2017; Kringos, Boerma, van der Zee, & Groenewegen, 2013), those with T2DM in Ghana may rely more heavily on their social networks, particularly family members, because of the lack of formalized, comprehensive support structures in the country (de-Graft Aikins, 2005). Thus, it is likely that the effects of social networks on HbA1c may be stronger in countries like Ghana, as compared to HICs. Further research is warranted to understand how these social networks may influence HbA1c control among Ghanaians with T2DM.

In Ghana, there are some indications that social networks can shape T2DM outcomes, but there is little documentation of how this happens. For example, Ghanaians living with chronic diseases often rely on family and friends to assist with chronic disease management, including paying for healthcare costs, but in certain instances dependence on family has led to strained relationships (Aboderin, 2004; Addai, Opoku-Agyeman, & Amanfu, 2014; de-Graft Aikins, 2006; Tagoe, 2012). Additionally, many low-income families struggle to provide continuous support over time for those with diabetes (D.-G. Aikins, 2004). However, there may be other ways in which a kin-focused network may affect HbA1c. With regards to network density, there is little research on its effects on health outcomes in the country. Compared to some HICs, Ghana has many household living arrangements, ranging from an extended family setup, nuclear family systems and instances in which married couples regularly live apart from each other to living with strangers in compound homes with communal bathrooms, toilets and open spaces for cooking and other activities (Annim, Awusabo-Asare, & Amo-Adjei, 2015; Awanyo, 2009; Gavu, Sasu, & Abedi, 2016). These living arrangements can impact children's

health outcomes and may be linked to psychological stress among adults (Annim et al., 2015; Awanyo, 2009). Taken together, these studies demonstrate that although family members, friends, and household members may play a role in HbA1c control in Ghana, there is minimal understanding of how they do so.

2.6 Social support

Social support is one of the most well documented mechanisms through which social networks affect health outcomes (Berkman & Kawachi, 2000; B. Uchino, 2009). Berkman and colleagues' (2000) conceptual model depicts the pathway from social networks through social support to health outcomes and serves as a framework for this dissertation research (Figure 2.1). Social support is defined as an assessment of the functions performed by an individual's social network members and the resources that he or she receives from network members (Thoits, 2011; Valente, 2010). Perceived support, which refers to the potential to get social support from network members based on previous experiences, is more strongly associated with positive health outcomes when compared to received social support (Lee et al., 2016; Thoits, 2011; B. Uchino, 2009; Y. C. Yang et al., 2016). Emotional support, informational support, instrumental support, and appraisal support are among the common types of social support, although there is little research about appraisal support (Barrera, 1986; Berkman, Glass, Brissette, & Seeman, 2000; Valente, 2010). Friends and family members are often the source of emotional support, which is expressed in the form of sympathy, care and concern for an individual's well-being (Valente, 2010). Informational support refers to the advice or recommendations that network members provide for addressing a specific situation (Thoits, 2011; Valente, 2010). Instrumental support is the help or aid with cooking,

grocery shopping, transportation or other tangible needs an individual may have (Berkman et al., 2000). There is research evidence that these forms of support may improve various health outcomes, including HbA1c (Berkman et al., 2000; Karlsen & Bru, 2013; Olowookere et al., 2015; Reblin & Uchino, 2008; Shavitt et al., 2016; Wang, Mittleman, & Orth-Gomer, 2005).

2.7 The links between social network characteristics and social support

Social networks are the channels through which social support is often obtained (Koetsenruijter et al., 2015; Lee et al., 2016; Valente, 2010). Existing associations between certain social network characteristics (specifically kin composition and density) and social support that are mainly found in the broader literature may be relevant for the context of T2DM. For example, denser networks have been associated with more social support (Haines et al., 2008). Kin composition research suggests that social networks with large proportions of kin may yield higher social support, although the evidence for this is inconsistent (Aboderin, 2004; Chung, Jeon, & Song, 2016; Haines & Hurlbert, 1992; Peek & O'Neill, 2001). Additionally, kin-focused networks provide more emotional and instrumental support than non-kin ties and networks with few kin members (Chung et al., 2016; Koetsenruijter, 2017; Peek & Lin, 1999). On the contrary, at least one study reports that friends provide more emotional and informational support than family members (Gallant, Spitze, & Prohaska, 2007). Associations between network characteristics and social support are evident, but more research is needed to clarify which network members are more likely to provide social support, particularly among people with T2DM in Ghana.

2.8 Social support and T2DM

Although there is extensive research on social support and HbA1c, there are discrepancies in the findings. A large body of evidence, mainly from systematic reviews of U.S. and European studies, indicates that increased social support, regardless of its source or how it was measured, is generally associated with improved HbA1c control among people with T2DM (Ford, Tilley, & McDonald, 1998; Stopford, Winkley, & Ismail, 2013; Strom & Egede, 2012). Two studies in Nigeria have shown these same associations (Adetunji, Ladipo, Irabor, & Adeleye, 2007; Odume, Ofoegbu, Aniwada, & Okechukwu, 2015). However, some studies, including one in South Africa, have found no significant or positive associations between social support and HbA1c (Chew, Khoo, & Chia, 2015; Chlebowy & Garvin, 2006; Gao et al., 2013; Griffith, Field, & Lustman, 1990; O'Connor, Crabtree, & Abourizk, 1992; Westaway et al., 2005). Previous research also shows that social support has an indirect effect on HbA1c by supporting self-care practices that result in improved HbA1c (Egede & Osborn, 2010; Gao et al., 2013). Chlebowy and Garving (2006) have suggested that the lack of association between social support and HbA1c in some studies may be the result of insufficient sample sizes and sample homogeneity.

What is most notable is that there is a dearth of research on these associations in LMICs, and the mechanisms linking social networks, social support, and T2DM have hardly been examined. The gaps in knowledge suggest that research must evolve to confirm how social support affects T2DM, especially in an LMIC context, and to document the pathways that may exist from social networks through social support to HbA1c. Ghana provides a unique context for this research. As the country's older adult

population—with a higher risk for T2DM—is rapidly growing, traditional support systems, mainly through family, are simultaneously collapsing or changing because of Ghana's weak economy, urbanization and changes in family priorities (Aboderin, 2004; Kpessa-Whyte, 2018; Mba, 2010). Examining social support and T2DM within this dynamic context may provide insight about effective social support sources for HbA1c control.

2.9 Gender differences in social support and T2DM outcomes

Limited research on gender in the U.S. and other HICs shows that there is mixed evidence regarding how social support affects HbA1c control for men and women with T2DM. While higher social support has been linked to lower HbA1c among men but not women in some settings, findings from other settings show a positive association between social support and adequate HbA1c control among women, but not men (Connell, Fisher, & Houston, 1992; Dai, 1995; Mondesir et al., 2016). Two studies that focused on the types of social support that are associated with improved HbA1c among men and women revealed conflicting findings for emotional, informational and instrumental support (Eriksson & Rosenqvist, 1993; Kacerovsky-Bielesz et al., 2009). Considering the small number of studies that have examined these gender differences, more research is needed to identify whether social support is more effective for men or women with T2DM. Such information will be useful in developing tailored, intervention strategies for HbA1c control.

Furthermore, HICs tend to have less rigid social structures, which are often linked to religious and cultural values, and that may shape gender roles and restrict women's

decision-making autonomy for health issues in many LMICs like Ghana (Osamor & Grady, 2016). At least one study has suggested that LMICs and HICs may have different types of issues that facilitate women and men's health inequalities. Study results indicated that employment, education, and marital status greatly accounted for differences in self-reported health between men and women in 18 countries from the WHO African region, while ageing trends greatly accounted for the differences in self-reported health between men and women in 19 countries from the WHO European region (Hosseinpoor et al., 2012). These findings provide additional support for conducting country or region-specific research because contextual and structural factors that affect gender differences in health may vary.

2.10 Social support research in Ghana

Although social support studies on people with T2DM in other countries provide examples of trends that may occur in Ghana, existing in-country findings on social support may also be useful in understanding the local context in which individuals with T2DM must function. MacLean (2011) has suggested that when some rural Ghanaians become ill and need support, they often look beyond family members, who may be just as poor as they are, and seek assistance from others, particularly friends, who have more resources. Such findings indicate that a friend-focused network may be more important for support provision in lower-income, rural Ghanaian settings, as friend-focused networks may have access to a broader range of resources than kin-focused networks. For example, previous work has demonstrated the utility of various aspects of social support in enabling better health among adults in Ghana (Dodor & Afenyadu, 2005; Razak M. Gyasi, Phillips, & Abass, 2018). However, there is still limited understanding about the

type of health-related social support that is often available and beneficial for rural and urban-dwelling Ghanaians, particularly those with chronic conditions like T2DM.

Research examining gender differences with respect to health-related support in Ghana is also scarce. In Northern Ghana, women from certain ethnic groups must consult their husbands, mothers-in-law, and sometimes others within the larger household for healthcare decision-making, whereas men do not have the same requirements (Moyer et al., 2014). What remains unclear is whether women within these types of cultural settings have easy access to health-related support outside of the home or family network and if their limited autonomy may be linked to delays in T2DM management and, consequently, poor HbA1c control. Specifically, women with T2DM who have lower decision-making autonomy may report receiving less social support even if they have dense networks that are mainly composed of kin and household members, thus adversely affecting their ability to control HbA1c. For those with high decision-making autonomy, it is possible that they may have easier control of financial and health-related resources in the home, consequently increasing the likelihood of better HbA1c control.

2.11 Stigma and T2DM

Stigma has been described as a fundamental cause of health outcomes (Hatzenbuehler, Phelan, & Link, 2013); thus, it may persistently have effects on the well-being of individuals with T2DM. Health-related stigma is regarded as "a social process, experienced or anticipated, characterized by exclusion, rejection, blame, or devaluation" (Weiss et al., 2006, p. 280). Stigma often occurs within the context of social relationships and ensues because there is an adverse social reaction to a feature or behavior that a

person may have because of a health condition (Vassilev et al., 2011; Weiss et al., 2006). Studies in HICs have shown that people with T2DM who feel stigmatized because of their disease report increased psychological distress, strained social relationships, social rejection, difficulty with disease management, higher levels of HbA1c and a lower quality of life (Browne, Ventura, Mosely, & Speight, 2016; Gredig & Bartelsen-Raemy, 2017; Liu et al., 2017; Schabert, Browne, Mosely, & Speight, 2013; Tak-Ying Shiu, Kwan, & Wong, 2003). The broader literature indicates that people who worry about being stigmatized may refuse to disclose their health condition or delay, reduce or terminate medical treatment, any of which may decrease their well-being (Earnshaw & Quinn, 2012; Person, Bartholomew, Gyapong, Addiss, & van den Borne, 2009). Thus, it is important to further evaluate diabetes-related stigma and determine how it may affect health outcomes for individuals with T2DM, particularly in LMICs where research on stigma has been limited.

2.12 Diabetes-related stigma, social networks, and social support

Some studies have examined how perceived social support may mediate the relationship between stigma and certain outcomes, including psychological well-being (Caserta, Pirttilä-Backman, & Punamäki, 2016; Wei, Li, Tu, Zhao, & Zhao, 2016). Previous research has also evaluated how social networks shape stigma and vice versa (Sibitz et al., 2011). In certain instances, the unwillingness to share chronic disease or mental illness diagnoses with family and friends for fear of stigma, ridicule or other reasons can hinder opportunities to receive support (Gaebel, Rössler, & Sartorius, 2016; Osamor, 2015). However, there is limited understanding of how stigma, social networks and social support are all interrelated. The same is true for diabetes-related stigma. At

least one study in Switzerland documented that people with diabetes who reported high levels of perceived stigma received less social support (Gredig & Bartelsen-Raemy, 2017). Considering that T2DM may require a lifetime of management within a social context, as well as the debilitating effects that stigma can have on health outcomes, there is a need for additional research to better understand the relationships between diabetes-related stigma, social networks, and social support. Within a Ghanaian setting, investigating whether and how diabetes-related stigma moderates associations between social network characteristics and diabetes-specific, social support may provide a better understanding of how stigma affects HbA1c.

Browne and colleagues (2013) developed a framework that reflects several causes, consequences, and experiences of diabetes-related stigma (Figure 2.2). This framework includes three types of stigma that have previously been described in the literature (Van Brakel, 2006). Enacted stigma refers to experiences of being shunned, socially neglected or being discriminated against by other individuals who sometimes restrict or deny a patient's access to resources, care, or some type of social support (Person et al., 2009; Van Brakel, 2006). Perceived stigma is apprehension about possible reactions from others towards one's disease status or its associated attributes because of the awareness that the specific disease or attribute usually draws negative attention (Van Brakel, 2006). Internalized or self-stigma occurs when a person begins to adopt feelings of shame, guilt and lower self-esteem (Van Brakel, 2006). Within the framework, these three forms of stigma are linked to behavioral, psychological, and medical challenges that individuals with T2DM may face (Browne, Ventura, Mosely, & Speight, 2013). Experiences of stigma, as documented within the framework, are based on data from

Australia where social and cultural values and beliefs that shape stigma may vary from those in LMICs like Ghana and potentially lead to different experiences of stigma and health outcomes for those with T2DM in LMICs. Diabetes-related stigma research in an LMIC context may reveal underlying social and cultural perceptions of the disease that can affect the well-being of affected individuals.

Cultural context has been identified as an important element in the broader research on stigma, but it is missing from the Browne et al. (2013) framework. Cultural context and social settings often determine what identities, behaviors, and appearances are considered as appropriate or normal, and what may be stigmatized or not (Goffman, 1986). Daily or routine activities that signal identification or disassociation with one's cultural group may be particularly important for understanding whether stigma will manifest (L. H. Yang, Thornicroft, Alvarado, Vega, & Link, 2014). Consequently, scholars have recommended that existing, local perceptions of the disease in question should be a key feature in stigma research (Link & Phelan, 2001; Weiss et al., 2006). For example, some people with T2DM and type 1 diabetes mellitus (T1DM), mainly in Australia and Europe, have expressed concerns about letting others know they have diabetes because people may think that those with diabetes are lazy, fat, or eat too much candy (Balfe et al., 2013; Browne et al., 2013; Browne, Ventura, Mosely, & Speight, 2014). However, even if other people associate diabetes with being overweight, it may be erroneous to assume that being fat is a stigmatizing condition in a country like Ghana where research suggests that, while some people consider being overweight as an indicator of poor health, others associate overweight with wealth and good health (Duda, Jumah, Hill, Seffah, & Biritwum, 2007; Frederick, Forbes, & Anna, 2008).

2.13 Stigma research in Ghana

At least one study in Ghana has focused on stigma among individuals with uncontrolled diabetes, with findings suggesting that stigma is linked to diabetes in two main ways. First, uncontrolled diabetes led to rapid weight loss, which was typically associated with HIV/AIDS in the rural communities where study participants lived (de-Graft Aikins, 2006). Consequently, these participants were labeled as having HIV/AIDS and experienced HIV-related stigma because of the drastic change in their physical appearance. This finding falls in line with one of the stigmatizing practices from Browne and colleagues' (2013) framework, which indicates that individuals with T2DM are often presumed to have some other type of stigmatized medical condition, but not diabetes. Secondly, the manifestation of chronic diseases in rural, Ghanaian communities was often linked to supernatural causes, as there were rumors that some study participants were involved in witchcraft (de-Graft Aikins, 2006). Experiences of HIV-related stigma and witchcraft stigma among study participants had negative health effects and resulted in depression, fear, anger, social isolation, loss of family financial support, and secrecy about disease status (de-Graft Aikins, 2006). Considering that this study was conducted over a decade ago, underlying cultural beliefs that facilitated HIV and witchcraft stigma among individuals with diabetes may potentially have changed, and such findings may not be representative of all rural communities or even urban Ghana. Furthermore, those who do not experience severe weight loss may deal with other challenges. Using a social network approach to study diabetes-related stigma in Ghana may reveal whether stigma affects potentially important network features that influence HbA1c control.

2.14 Religion, social support, and T2DM

Several studies, mainly in HICs, have provided extensive evidence of the beneficial effects of religion on health (Ellison & Levin, 1998; Koenig, 2012; Moreira-Almeida, 2013; Zimmer et al., 2016). However, findings from a recent study of 93 countries have revealed that increased participation in religious activities is more likely to be associated with improved health outcomes in countries that are perceived as religiously diverse (Zimmer et al., 2019). Theoretically, the level of participation in religious activities is one way in which religion influences health (Kodzi, Obeng Gyimah, Emina, & Chika Ezeh, 2011). Church/mosque attendance provides additional opportunities for social interaction and is associated with increased emotional support, the provision of spiritual reinforcement through prayer, higher satisfaction with health outcomes, improved mental health and overall well-being (Chaaya, Sibai, Fayad, & El-Roueiheb, 2007; Krause & Wulff, 2005; Krok, 2014; Nagy, 2016; VanderWeele, Li, Tsai, & Kawachi, 2016). There is evidence suggesting that religion affects health outcomes among individuals with T2DM (Darvyri et al., 2018). Studies in the U.S. show that religion and spirituality significantly improve HbA1c control among Black women, enable coping among Black men, and are generally useful for perseverance and resilience in T2DM management (Choi & Hastings, 2018; Namageyo-Funa, Muilenburg, & Wilson, 2015; Newlin, Melkus, Tappen, Chyun, & Koenig, 2008). Research in Ethiopia, Iran, Malaysia, and Mexico has also demonstrated the utility of religion in T2DM management and control (Habte, Kebede, Fenta, & Boon, 2017; Heidari, Rezaei, Sajadi, Ajorpaz, & Koenig, 2017; How, Ming, & Chin, 2011; Rivera-Hernandez, 2016). Australians with T2DM and or cardiovascular disease reported that by participating in religious practices

and spiritual healing groups, they received social support through church networks and obtained a renewed sense of hope to cope with their illness (Unantenne, Warren, Canaway, & Manderson, 2013).

While these T2DM/religion studies have focused on different outcome variables, many of them have also examined social support. Direct and indirect effects of religion on health have previously been established (Morton, Lee, & Martin, 2017). Findings, mainly from HICs, suggest that social support may be an important explanatory mechanism for links between religion and health (Darvyri et al., 2018; Koenig, 2012). Religious institutions provide a context for social support exchange that often extends across the life course, and there is some evidence that social support from church members has been linked to improved health outcomes, especially among older adults (Krause, 2008; Taylor & Chatters, 1988). Many studies have identified significant positive associations between religion and social support, and others have found evidence that support mediates associations between religion and various health outcomes (Assari, 2013; Holt, Schulz, Williams, Clark, & Wang, 2014; Koenig, 2012; Morton et al., 2017). Additionally, Watkins and colleagues (2013) found that social support obtained from one's religious community may be a significant predictor of all diabetes self-care activities except physical activity. Currently, there is hardly any research that has simultaneously examined religious participation, social support and HbA1c to confirm how these factors may be linked. More research is needed to understand these relationships and to determine how, if at all, religious participation affects HbA1c.

2.15 Religion and T2DM in Ghana

Ghana has been described as one of the most religious countries in sub-Saharan Africa (Takyi & Lamptey, 2016). Approximately 96% of Ghanaians have some type of religious affiliation (Takyi & Lamptey, 2016; WIN-Gallup International, 2012). Nearly 71% of the population identifies as Christian, 17.6% identifies as Muslim, and 5.2% of the population has traditional beliefs (CIA, 2017). For these reasons, the names given to Ghanaian people, institutions, shops, and businesses often reflect religious sentiments (Akotia, Knizek, Kinyanda, & Hjelmeland, 2014). Participation in religious activities is high, especially among women (Gyimah, Adjei, & Takyi, 2012). Faith institutions have established several hospitals, schools, and universities in the country (Addai et al., 2014; Opokua, 2015; Pokimica, Addai, & Takyi, 2012). In addition, certain Christian groups may provide social and economic resources for their members during difficult times (Pokimica et al., 2012).

Previous work in Ghana has examined various aspects of religion with respect to health. For example, one study has indicated that participation in religious activities may be a vital mechanism for the creation of social networks that can impact Ghanaians' well-being (Addai et al., 2014). Religious program attendance may be associated with better self-rated health among Ghanaians, and some turn to prayer in addition to the use of a biomedical regimen for diabetes management (Addai et al., 2014; de-Graft Aikins, 2005). The previous study on diabetes stigma in Ghana also found that some study participants used church activities as a coping strategy for their well-being (de-Graft Aikins, 2006). However, it is unclear how participation in religious activities or religious program attendance improves biomedical outcomes, such as HbA1c, particularly for chronic

conditions like T2DM that require long-term management. The current body of religious research in Ghana can expand to investigate how, if at all, religious participation affects T2DM outcomes.

2.16 Traditional medicine

Traditional medicine (TM) is the use of indigenous approaches evolving from beliefs and experiences, which include herbal remedies, the consultation of spiritual elements, and a combination of spiritual and herbal sources, for maintaining health, disease prevention and treatment (Mokgobi, 2014; World Health Organization, 2013). The World Health Organization has outlined strategies to assist countries in identifying ways through which TM can be effectively and safely integrated into existing health systems, but many of them, including Ghana, lack research and stringent policy implementation efforts (Kretchy, Owusu-Daaku, & Danquah, 2014; Nyaaba, Masana, Aikins, Stronks, & Agyemang, 2018; World Health Organization, 2013). In Ghana, TM has been used for several centuries, and although efforts to facilitate collaborations between TM and biomedicine have occurred across the country, integration has been limited (R. Gyasi, Mensah, Adjei, & Agyemang, 2011; Kpobi & Swartz, 2018). For instance, Ghana's Traditional Medicine Practice Act and the Ministry of Health's Traditional and Alternative Medicine Directorate are concrete examples of mechanisms that are in place to promote and regulate TM products and services (Kasilo, Trapsida, Mwikisa, & Lusamba-Dikassa, 2010; Nyaaba et al., 2018), but their effects are hardly documented. TM is mainly used for improving health in Ghana because it is easily accessible, perceived as natural or organic, relatively cheaper, and often more aligned with local values and beliefs about disease manifestation and health in comparison to

biomedical strategies (R. Gyasi et al., 2011; Razak Mohammed Gyasi et al., 2016; Kpobi & Swartz, 2018). It is estimated that nearly 80% of rural Ghanaians use TM as a means for primary healthcare (Krah, de Kruijf, & Ragno, 2018). The country's TM practitioner-to-population ratio is 1:200, while the physician-to-population ratio is 1:25, 000 (Kasilo et al., 2010). Fetish priests, herbalists, and spiritualists are examples of TM practitioners who operate through various mechanisms and are more prominent in rural areas of Ghana (Mill, 2001; S. Antwi-Baffour, 2014). Certain TM products and services are publicly advertised on TV, radio, in buses, and marketplaces in Ghana (Nyaaba et al., 2018).

Some diabetes studies among Ghanaians have highlighted certain instances in which TM is used for disease management. Some individuals with diabetes consulted TM practitioners because of what appeared to be the sudden onset of their disease symptoms, which they perceived as being caused by witchcraft (de-Graft Aikins, 2005). Study participants perceived the use of Christian prayer and other Christian practices as a form of spiritual intervention for diabetes management (de-Graft Aikins, 2005). Furthermore, family members of some individuals with diabetes have encouraged the use of TM instead of biomedical strategies because of concerns about a prolonged recovery from amputation and potential disease complications (de-Graft Aikins, 2005). However, some individuals adopted biomedical strategies for diabetes management when they experienced adverse health outcomes from TM (de-Graft Aikins, 2005). Others resorted to TM because it was cheaper than biomedical therapy, there was pressure from friends and family to use more natural healing approaches, and there were also beliefs that spiritual healers could cure diabetes without the use of medication (Atinga, Yarney, &

Gavu, 2018). In certain instances, family members may consult a TM practitioner to identify causes of disease on behalf of a chronically ill relative (Atobrah, 2012).

2.17 Summary of the literature and gaps in knowledge

In Ghana, there are limited national and institutional resources for individuals with chronic conditions like T2DM, so patients are often compelled to turn to their social networks to seek assistance with disease management. However, there is limited information on how these networks are relevant for T2DM. Previous literature, particularly from HICs, has revealed several key findings that can be concurrently examined to identify social network-related factors that may pertinent for HbA1c control. First, it has been argued that social networks operate through social support to shape health and well-being. Family and household members (kin and household composition), as well as the interconnectivity among network members (network density), are among predominant network characteristics that have been linked to health outcomes like HbA1c. Second, a plethora of studies has established links between social support and HbA1c, but evidence is mixed. Third, there are gender differences in how social networks operate, yet gender differences have hardly been examined in the context of T2DM in LMICs like Ghana. Fourth, diabetes-related stigma, both in Ghana and elsewhere, may impact T2DM management, but the potentially complex relationships among stigma, social networks, and HbA1c need further examination. Finally, religious participation and TM are both coping strategies that affect health outcomes, but their links to HbA1c control among Ghanaians with T2DM are unknown.

2.18 Purpose of the study and conceptual framework

The goal of this dissertation research was to examine social network factors that may influence HbA1c control among individuals with T2DM in Ghana. Adopting a social network approach was useful in examining whether kin composition, household composition, and network density operated through social support to influence HbA1c among Ghanaians with T2DM, and whether these mechanisms differed among men and women. Findings from this research indicated whether relationships among social network characteristics, social support and HbA1c that have been established elsewhere also existed within a Ghanaian context. Additionally, assessing the interplay among stigma, social networks, and social support, as well as the roles of religious participation and TM, was useful in identifying social and structural factors that concurrently impact HbA1c. The specific aims and hypotheses for this study were as follows:

Specific Aim 1: To examine relationships between social network characteristics (kin composition, household composition and network density) and HbA1c among adults with T2DM in Kumasi, Ghana.

Hypotheses

H1a. Social network characteristics (higher kin composition, higher household composition and higher network density) will be associated with decreased HbA1c.

H1b. The relationships between social network characteristics (kin composition, household composition and network density) and HbA1c will be mediated by perceived diabetes social support, such that those with higher social support will have decreased HbA1c.

Specific Aim 2: To examine how gender and stigma modify the relationships between social network characteristics (kin composition, household composition and network density) and HbA1c among adults with T2DM in Kumasi, Ghana.

Hypotheses

H2a. The relationships between social network characteristics (kin composition, household composition and network density) and perceived diabetes social support will be moderated by diabetes-specific stigma, such that that those with higher stigma levels will have less social support and increased HbA1c.

H2b. The direct effect of social network characteristics (kin composition, household composition and network density) on HbA1c will differ between men and women.

H2c. The indirect effect of social network characteristics (kin composition, household composition and network density) on HbA1c, via perceived diabetes social support, will differ between men and women.

Specific Aim 3: To examine the effects of religious participation and the use of traditional medicine (TM) on HbA1c control among adults with T2DM in Kumasi, Ghana.

Hypotheses

H3a. Increased religious participation will be associated with decreased HbA1c.

H3b. The relationship between religious participation and HbA1c will be mediated by social support such that those with higher social support will have decreased HbA1c.

H3c. Increased use of TM will be associated with increased HbA1c.

Findings from the research explored mechanisms through which social networks affect HbA1c, while providing insight into the ways through which gender, stigma, and religion may shape social support, enable access to resources and facilitate the well-being of individuals with T2DM in Ghana. A separate conceptual model is provided for each specific aim to identify the hypothesized relationships (Figures 2.3-2.5). Berkman and colleagues' (2000) depiction of how social networks influence health outcomes provided the framework for the conceptual models. They proposed that social relationships exert indirect influences on individuals' behaviors and health outcomes through social support as a potential mechanism (Berkman et al., 2000). Social network characteristics examined in the dissertation research focused on network structure and composition. Specifically, documenting and analyzing the proportions of kin composition and household composition within study participants' networks helped identify the types of networks that can influence HbA1c. It was predicted that a higher kin composition and higher household composition among alters of people with T2DM would be associated with decreased HbA1c. Network structure, in the form of network density, assessed the links between alters that can affect access to T2DM-related resources, behaviors of affected individuals, and, consequently, HbA1c. Similarly, it was expected that a higher network density, indicating more connectivity among alters, would be associated with better HbA1c control.

Perceived social support is often obtained through social networks and has been strongly associated with HbA1c control (Stopford et al., 2013); thus, it is a potentially good mediator between social network characteristics and HbA1c (Figure 2.3). The mechanisms that link social network characteristics to HbA1c via perceived diabetes

social support (PDSS) were examined to provide an understanding of whether both social networks and social support were important components for improving the health of Ghanaians with T2DM.

Additionally, stigma and gender were each expected to moderate the associations between social network characteristics and HbA1c via social support (Figure 2.4). Gender is a potentially important moderator because previous research has indicated that men and women's social networks vary and their access to social support may be different (Fischer & Oliker, 1983; Kawachi & Berkman, 2001). While examining social networks, social support and HbA1c concurrently, any gender-specific differences that were observed had implications for future diabetes interventions. Furthermore, the presence of stigma may alter the extent to which social support is perceived to exist, but few studies have looked at its effect on the links between social network characteristics and social support. The dissertation research examined this relationship and identified whether diabetes-related stigma influenced HbA1c in Ghana.

Finally, religious participation and TM were included in the third conceptual model (Figure 2.5) because they are predominant aspects of Ghana's social and cultural landscape and have previously been linked to well-being among Ghanaians (Addai & Adjei, 2014; Razak Mohammed Gyasi et al., 2016; Pokimica et al., 2012). Given the limited evidence from LMIC-specific studies on religion and health, religious participation, social support, and HbA1c were examined concurrently to provide new insights about the effects of religion, with implications for the development or design of future health interventions. Furthermore, TM was evaluated to identify the extent to which it was a coping strategy and its effects on HbA1c control.

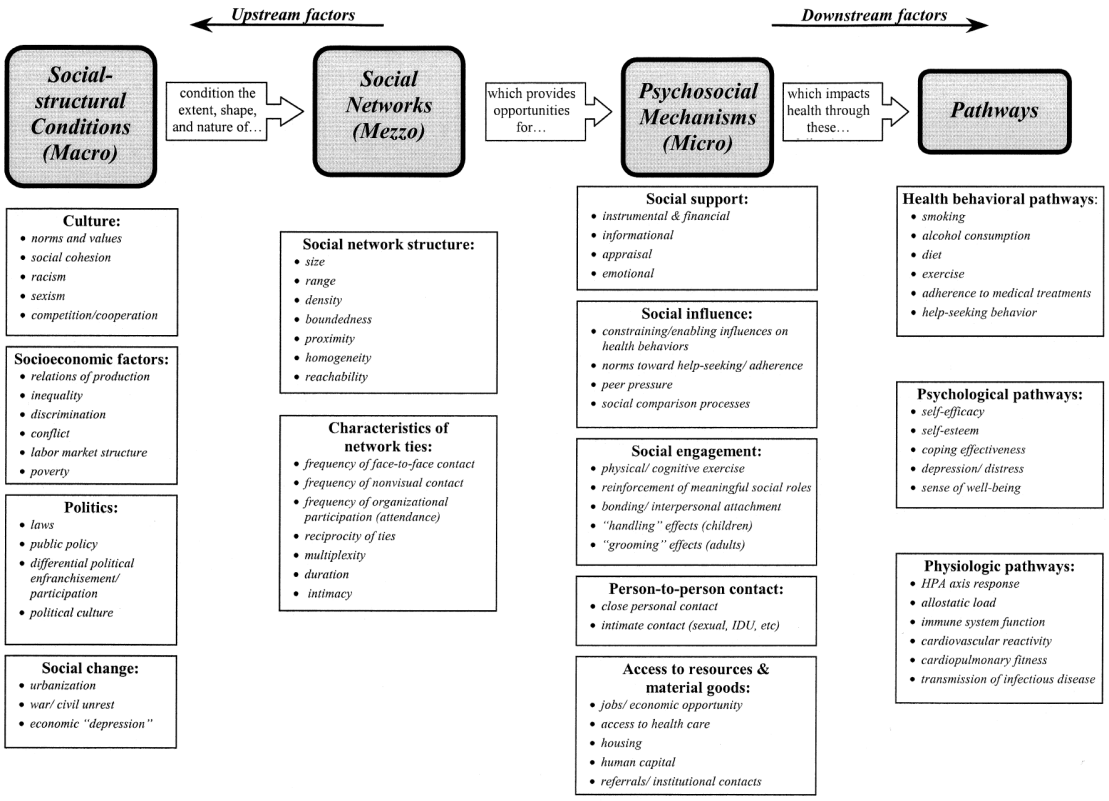

Figure 2.1 Conceptual model of social networks' influence on health (Berkman et al. 2000)

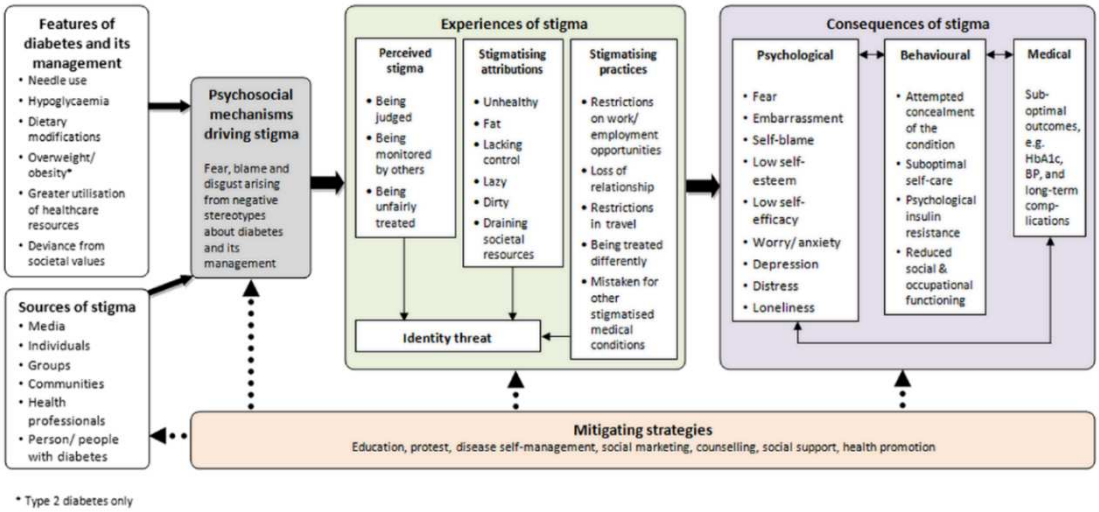

Figure 2.2. A revised framework to understand diabetes-related stigma (Browne et al., 2013)

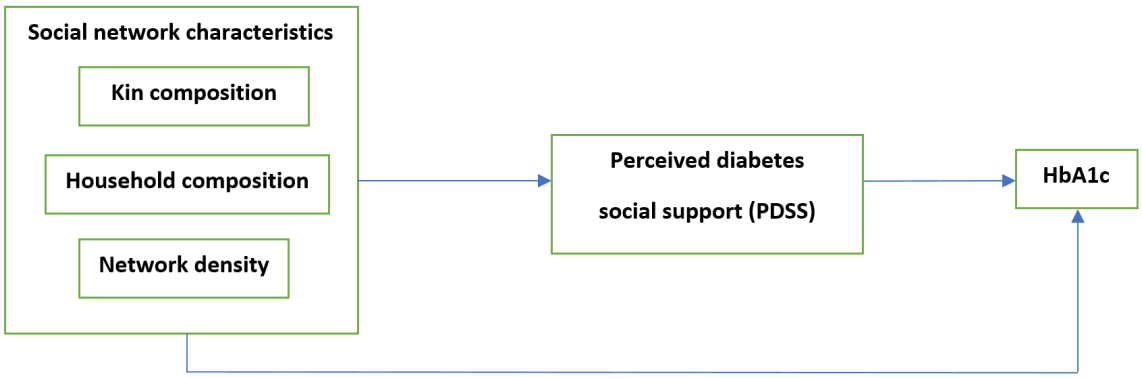

Figure 2.3 Conceptual model of factors that may impact HbA1c among individuals with T2DM in Ghana-Specific Aim 1

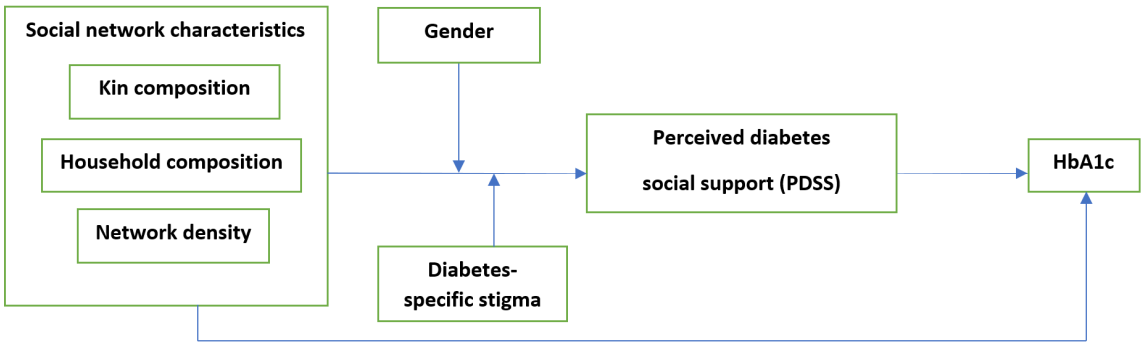

Figure 2.4 Conceptual model of factors that may impact HbA1c among individuals with T2DM in Ghana-Specific Aim 2

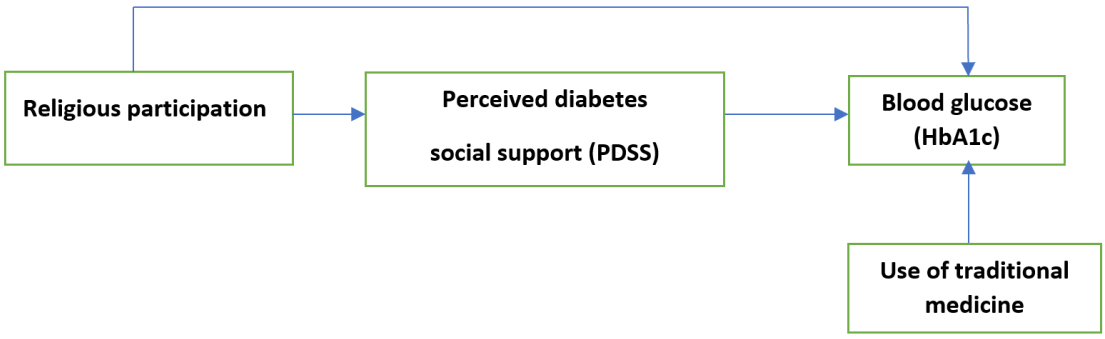

Figure 2.5 Conceptual model of factors that may impact HbA1c among individuals with T2DM in Ghana-Specific Aim 3

CHAPTER 3

RESEARCH DESIGN AND METHODS

3.1 Overview

Primary data were collected through a cross-sectional survey of 254 noninstitutionalized, T2DM patients at the diabetes clinic of the Komfo Anokye Teaching Hospital (KATH) in Kumasi, an urban city in southern Ghana and the capital city of the Ashanti region. KATH is the second largest hospital in the country, and it is the main referral hospital for most of Northern Ghana (Kretchy, Owusu-Daaku, & Danquah, 2013). Permission was granted to collect data at the KATH diabetes clinic on Tuesdays, Wednesdays, and Fridays each week. This study was approved by the Institutional Review Board at the University of South Carolina, Narh-Bita Hospital Ltd., and the Committee on Human Research, Publication and Ethics for the Kwame Nkrumah University of Science and Technology and KATH.

3.2 Participants

From July 17, 2018 to August 17, 2018, a cross-sectional survey was conducted at KATH's diabetes clinic. Eligible study participants were more than 18 years old, had been diagnosed with T2DM for at least a year, and were fluent in English or Twi. Based on diabetes type and length of disease, trained research staff generated a daily list of potentially eligible participants by screening medical records of routinely scheduled patients who were present for a clinical visit. After the nurse on duty made a general

announcement to patients in the waiting area about the study, potential participants were approached by one of six trained, bilingual research staff members and provided with more details about the study. Verbal and written informed consent were then administered in English or Twi to patients who were found to be eligible to participate in the study. Patients who consented to participate received a signed copy of the consent form for their records. A total of 268 patients were approached, and 256 consented to participate in the study. One interview was terminated mid-way after discovering that the patient had difficulty hearing, yielding 255 completed interviews. Data from one of those completed interviews was not included after learning that the patient was a prisoner. Thus, data from 254 community-dwelling patients were retained for analytical purposes. There were 12 patients who decided not to participate for various reasons including lack of interest in the study, experiences from previous studies, and poor health at that time.

3.2a Sample size calculation

A two-step process was used to determine the sample size for applying a mediation analysis approach. The procedure for conventional mediation analyses was applied, and it involved the use of regression-based tests to estimate the mediated (indirect) effect of an exposure variable on an outcome (Fritz & MacKinnon, 2007). For this study, exposure variables were social network characteristics and frequency of religious participation. The outcome variable was HbA1c. The first step was to identify sample size recommendations for the mediation approach. Based on iterations of sample simulation, Fritz and MacKinnon (2007) have provided a table of empirical estimates of sample sizes that are needed to achieve 80% power and detect the mediated effect of an exposure on an outcome. They indicate that for meditation to be present, four statements

must be true: 1. the total effect of the exposure on the outcome (τ) must be significant; 2. the effect of the exposure on the mediator (α) must be significant; 3. the effect of the mediator on the outcome while controlling for the exposure (β) must be significant; and 4. the direct effect of the exposure on the outcome adjusted for the mediator (τ^{l}) must be non-significant (Fritz & MacKinnon, 2007). The appropriate values (effect sizes) for α and β, pairs of which were associated with a specific τ, had to be identified from the literature to select the sample size estimate from the table (Fritz & MacKinnon, 2007).

The second step was to find previous studies that calculated effect sizes of various factors, such as self-care and social support, on HbA1c. Two studies indicated that statistically significant effect sizes were 0.21% and 0.24% respectively (Gao et al., 2013; Patil et al., 2016). Within the sample size table, the closest value to the aforementioned effect sizes was 0.26 for both α and β. Consequently, it was estimated that a sample size of 224 was needed to achieve 80% power and to detect the mediated effect of independent variables on HbA1c ($\alpha = 0.26$, $\beta = 0.26$; $\tau = 0.14$) (Fritz & MacKinnon, 2007). A total of 254 individuals were interviewed for the study.

3.3 Data collection

A nurse at KATH's diabetes clinic measured HbA1c levels for study participants. Oral questionnaire administration, which occurred in a private setting at the diabetes clinic, took approximately 40 minutes per participant, and research staff recorded the responses on paper questionnaires. The costs of the HbA1c test were covered through the study, and each patient received an incentive of 15.00 Ghana cedis (approximately $3.4) after completing the questionnaire. To ensure that no participants were interviewed twice

during the period of data collection, a sticker was placed on the medical record of each study participant to indicate that he or she had already completed the study. In addition, the participants' names were recorded in a master list, which was compared to the list of patients appearing in the clinic on subsequent days of data collection to ensure that patients were only approached and interviewed once.

3.4 Measures

3.4a. Participants for pretesting procedures

Between May and July 2018, 14 study participants were recruited for cognitive interviews using a convenience sampling approach. The pretesting process was important because there was little evidence that several scales and items had been used among Ghanaians with T2DM or in the Twi language that is predominantly spoken in the Kumasi area. Cognitive interviewing was a valuable step for examining how those with T2DM thought through, understood and responded to the questionnaire content and in determining if any instructions, questions, or response options needed revisions. Potential participants were recruited from the main outpatient clinic (OPD) at Narh-Bita Hospital in Tema and considered eligible to participate in the cognitive interviews if they identified as Ghanaians with T2DM who were at least 18 years old and fluent in either English or Twi. Medical appointments for diabetes patients at the hospital were on Tuesdays and Fridays, so recruitment and interview processes occurred on those days.

3.4b. Data collection for pretesting procedures

Patients were approached about the study while waiting to see the physician at the OPD or after their medical appointment. A doctor or nurse on duty confirmed diabetes

type for each patient who was approached. In a private setting at the OPD, patients received more details about the study, and those who were eligible and interested in participating provided written informed consent and indicated their language preference for the interview. Each participant received a copy of the consent form before the interview. Sixteen patients were approached about the study, and 14 consented and completed a cognitive interview. Demographic information on cognitive interview participants is presented in Table 3.1.

Each cognitive interview was audio recorded and lasted for approximately 75 minutes on average. Audio recordings were stored on password-protected devices to ensure participant confidentiality. In addition to the audio recordings, notes were taken during each interview to indicate whenever participants had difficulty with certain expressions or terms among the survey items or if there were other issues that had to be addressed. Each participant received a post-incentive of 15.00 Ghana cedis (approximately $3.4) at the end of the interview. The PI conducted all cognitive interviews. Notes and recordings were used to finalize the questionnaire used in the survey of T2DM patients at KATH.

3.4c. Measures for pretesting procedures

For the cognitive interviews, a structured interview guide that incorporated concurrent, standardized verbal probes for each questionnaire item was initially developed in English and then professionally translated into Twi (Appendix A). The guide was designed to pretest items assessing perceived diabetes social support (PDSS), diabetes stigma, frequency of participation in religious activities, one's sense of

belonging in a religious institution, monthly income, use of traditional medicine (TM), and characteristics of participants' social networks. Instructions for the interview, scale items, corresponding response options and all verbal probes were made available in English and Twi. Although most probes focused on question comprehension, probes that examined the retrieval and judgement stages of cognitive processing were also included. Each item was read to study participants and, after responding, participants answered the corresponding probes.

3.4d. Analysis for pretesting

All interviews were transcribed and examined together with field notes. Findings from the English interviews were examined side by side with those from the Twi interviews to determine if there were any patterns in the challenges with items, response options or instructions. A rule of thumb for concluding that an item or response option was challenging was that if at least two patients had problems explaining a phrase, responding to an item or to a probe, then that item needed to be re-examined.

3.4d. Variables for final data collection

Based on the findings from the cognitive interviews, variables in the final questionnaire (Appendix B) were operationalized as follows:

Dependent variable

HbA1c

An SD BIOSENSOR, standard A1cCare Analyzer and test kits (SD A1cCare Analyser, n.d.) were used to assess patients' HbA1c levels, and the raw values were

treated as continuous data for analytical purposes. HbA1c assessments were successfully completed for 234 participants.

Independent variables

Network size: Two name generator questions were used to identify individuals (alters) within study participants' social networks. For the first question, participants were asked to name a maximum of three people with whom they discussed important matters. For the second question, participants were asked to name a maximum of three people who assisted them with household tasks. Network size was operationalized as the total number of alters identified through the name generators and ranged from 0-6.

Kin composition: Kin composition was assessed by asking participants to indicate if each alter was a spouse or an unmarried partner, child, other relative, friend, or some other connection. Kin composition was calculated by summing the number of alters that each participant identified as a spouse, child, or relative and then dividing this number by the total number of unique alters mentioned by each participant. The final kin composition variable ranged from 0 to 1, with higher proportions indicating that most of the alters were family members.

***Household composition*:** Household composition was assessed by asking each participant to indicate if he or she currently lived with any of his or her named alters and then dividing the number of alters who lived with each participant by the total number of named alters. The household composition variable ranged from 0 to 1, with higher proportions indicating that most of the alters were household members.

Network density: Network density was measured by asking each study participant to indicate whether named alters had relationships with each other as friends, family members, or some other type of connection using binary responses of "yes" or "no" for each alter-alter dyad in a person's network. These responses were used to calculate network density with the formula:

$$\textit{Network density} = \textit{\# of ties present} / [(n(n-1))/2]$$

where *# of ties present* referred to the total number of connections among alters in the network and *n* was the network size (Valente, 2010). The network density variable ranged from 0 to 1, with higher proportions indicating that most alters had some type of connection to each other.

Frequency of participation in religious activities: This variable was measured using responses to four items. Two items were obtained from the religious public practices subscale from the Multidimensional Measurement of Religiousness/Spirituality instrument (Fetzer Institute/ National Institute on Aging Working Group, 2003), which measures the frequency of attendance at religious services and other activities in a place of worship. Two additional items were created by the study team: "How often do you take part in Bible study groups, religious prayer meetings, or other religious activities somewhere other than a place of worship?" and "How often do you take part in volunteer activities that are organized by your religious group?" The intent of these items was to capture other common activities, like communal praying, that some religious groups organize in Ghana but do not always occur at a formal place of worship (Reinhardt, 2017). The religious public practices subscale typically uses a 9-point Likert scale with response options ranging from "never" (=1) to "several times a week" (=9) (Fetzer

Institute/ National Institute on Aging Working Group, 2003). However, in order to minimize questionnaire burden for both the participants and interviewers (Dillman, Smyth, & Christian, 2014), two response options ("about once a year" [=2] and "nearly every week" [=7]) were dropped from the response scale for the present study, and an additional response option for "every day" (=8) was included to accommodate study participants who may be engaged in daily religious activity. The revised 8-point Likert scale ranged from "never" (=1) to "every day" (=8). All four items were combined to compute an average score for religious participation, with higher scores indicating more frequent religious participation (α=0.75).

***Frequency of seeking care from Traditional Medicine (TM) practitioners*:** Three items were developed to measure the frequency with which participants consulted TM practitioners for T2DM management. The first item measured participants' use of herbalists, the second item measured participants' use of spiritualists, and the third item measured the use of fetish priests. All items were accompanied by a 5-point Likert scale with response options ranging from "never" (=1) to "always" (=5). Responses to these items were combined to compute an average score indicating the frequency of use of these alternate sources of T2DM management, with higher scores reflecting more frequent use of these sources (α=0.62).

Perceived diabetes social support (PDSS): Perceived diabetes social support (PDSS) was measured as a continuous variable using eight items from the emotional/informational support subscale and four items from the tangible (instrumental) support subscale from the Medical Outcomes Study Social Support Survey (MOS-SSS).(Sherbourne & Stewart, 1991). MOS-SSS was initially created to evaluate access to different types of support

among patients with chronic conditions including diabetes (Sherbourne & Stewart, 1991). A systematic review shows that it is the most commonly used measure of social support for diabetes studies (Al-Dwaikat & Hall, 2017). All 12 MOS-SSS items were modified to assess diabetes-related support outside of a clinical setting. Based on previous research in Ghana indicating that financial support for health purposes is often lacking from social networks, particularly family members (MacLean, 2011), an item about financial support was created by the study team and added to the instrumental support subscale. Participants were asked, "how often do you have access to someone who can help you pay for your diabetes medical expenses?" All items used the original MOS-SSS 5-point Likert scale ranging from "none of the time" (=1) to "all of the time" (=5). The average of responses to all 13 PDSS items was calculated to form a single scale score, and the PDSS scale demonstrated high internal consistency for the study sample (α=0.87).

Moderating variables

Diabetes stigma: Diabetes-related stigma was measured using 28 items, 16 of which were adapted from the 19-item, Type 2 Diabetes Stigma Assessment scale (DSAS-2), which consisted of three subscales and was originally developed in Australia (Browne, Ventura, Mosely, & Speight, 2016). The study team developed seven items to expand on existing DSAS-2 items and five additional items based on previously published stigma research in Ghana and four other LMICs (de-Graft Aikins, 2006; Genberg et al., 2009; Person, Bartholomew, Gyapong, Addiss, & van den Borne, 2009). For example, a DSAS-2 scale item asked if a person with T2DM was excluded from social occasions involving food or drink that others thought he or she should not have. One of the new items asked if this type of restriction also occurred at home. Another item that was based on LMIC

research asked, "how often do people mistake you for having HIV/AIDS because of your diabetes?" A 5-point Likert scale that ranged from "never" (=1) to "very often" (=5) was used to measure the frequency of participants' stigma-related experiences and perceptions. The diabetes-related stigma variable was computed to form a single scale score by averaging responses across all items, and it demonstrated high internal consistency (α=0.88). Higher scores on the diabetes-stigma scale indicated more frequent stigma. The treated differently subscale assessed enacted stigma (11 items; α=0.68), the blame and judgment subscale assessed perceived stigma (11 items; α=0.82), and the self-stigma subscale was a measure of internalized stigma (6 items; α=0.81).

Gender: Participant gender was obtained from participants' medical records since it is can be considered culturally inappropriate to ask someone in Ghana whether they are male or female.

Sociodemographic variables and health-related characteristics

Several variables were included to characterize study participants: age in years; ethnicity (Akan, Ewe, Grussi, Hausa, Mole Dagbani, or other); monthly income (less than 200 Ghana cedis, 200-499 Ghana cedis, 500 Ghana cedis or more); work status (employed full time, unemployed, retired, or other); level of education (0-6 years of education, completed junior secondary school [JSS][1], completed senior secondary school [SSS][2] or higher); whether the participant lived in Kumasi at the time of the study (yes or no); language use for interview purposes (English or Twi); religious affiliation (Christian, Muslim, traditional religion, does not identify with any religion); current health insurance

[1] JSS is equivalent to middle school in the U.S.
[2] SSS is equivalent to high school in the U.S.

coverage (yes or no); number of self-reported, T2DM comorbidities; family history of T2DM (yes or no); and duration of T2DM in years (time since diagnosis).

3.5 Data management and analysis plan

Data management

The PI entered all responses from the paper questionnaires into a database file on a password-protected computer. A backup copy of the electronic data was stored on an external hard drive and on a password-protected, cloud storage service. Paper questionnaires were kept in folders in a secure room.

Overall analytical process

An alpha value of 0.05 was applied for all statistical analyses, which were performed using SAS® 9.4 software (SAS Institute Inc., 2013). Univariate and bivariate analyses were run on all variables to better understand the data distributions and check for correlations, which were used to inform subsequent variable creation and statistical modeling decisions. Income and education demonstrated a moderate but significant correlation ($r=0.40$, $p <0.0001$). Since the education variable had less missing data than income, only education was included in subsequent multivariable analyses. Additionally, correlations among the main variables in the study were examined (Table 3.2). Results indicated that there were small but significant correlations between kin composition and household composition, network size and network density, network density and social support, network size and social support, frequency of participation in religious activities and frequency of seeking care from TM practitioners. There were no other significant correlations among the variables. The analysis procedure for each aim is described below.

Analysis for Aim 1

We used multivariable linear regression models to estimate three types of associations: 1) associations between HbA1c and each social network characteristic separately (kin composition, household composition, and network density); 2) associations between PDSS and each social network characteristic separately; and 3) the association between PDSS and HbA1c. For each association, we ran crude models, partially adjusted models (including only age, gender, and duration of T2DM as covariates), and fully adjusted models, which included all covariates (age, gender, duration of T2DM, T2DM comorbidities, and level of education).

We then applied a mediation approach to estimate the indirect effect of each social network characteristic (via social support) on HbA1c. Mediation analyses require that potential confounders must be considered and included when examining associations between the exposure, the mediator and the outcome (Valeri & Vanderweele, 2013; VanderWeele, 2016). In this study, the exposure variables were the three network characteristics, the mediator was social support, and the outcome was HbA1c. For social support to be considered a mediator, there must be a significant association between a network characteristic and social support as well as a significant association between social support and HbA1c. To test for mediation, we used a SAS macro that allowed for exposure-mediator interactions, and we adjusted for all covariates, while applying the embedded bootstrapping option to generate 1000 bootstrap samples to obtain standard errors and confidence intervals (Valeri & Vanderweele, 2013).

Analysis for Aim 2

Gender analyses

We also examined gender differences in the associations among social network characteristics, social support and HbA1c. First, we tested for interactions between participants' gender and each social network characteristic in three fully adjusted, linear regression models with HbA1c as the dependent variable. Secondly, we tested for interactions between gender and social network characteristics in three fully adjusted, linear regression models with PDSS as the dependent variable. Finally, we tested for interactions between gender and social support in a fully adjusted, linear regression model with HBA1c as the dependent variable. Results from these models provided evidence for whether there was a need to further stratify the analyses by gender.

Stigma analyses

To determine if there were any significant differences among study participants based on diabetes-related stigma, the median value for stigma was used to stratify the sample into two groups: individuals with moderate stigma and those with low stigma. Differences between these groups were examined using Pearson chi-square tests for categorical variables and t-tests for continuous variables. Secondly, we ran three multivariable linear regression models to estimate the influence of the three social network characteristics (kin composition, household composition, and network density) on social support. To examine the role of each type of stigma (perceived stigma, enacted stigma, and self-stigma) as a moderator, we ran additional models to evaluate the influence of each network characteristic on social support while including an interaction

term for the network characteristic and each type of stigma in separate models. Network size is an important factor that affects other network characteristics and indicates the boundary of each network (Valente, 2010), therefore, we controlled for size in all models that included any of the three network characteristics as an independent variable. Thirdly, we used a multivariable linear regression model to estimate the influence of social support on HbA1c. We also ran additional models to examine the effect of each type of stigma as a moderator of the relationship between social support and HbA1c. We adjusted for age, gender, education, number of T2DM comorbidities, and duration of T2DM in all models, and those that included a statistically significant interaction term provided evidence for further stratifying the analyses.

Analysis for Aim 3

An ANOVA test was used to determine whether the frequency of participation in religious activities differed across study participants with varying Christian denominations. Results indicated that there were no significant differences in the average frequency of participation in religious activities across denominations ($F=1.24$, $p=0.27$), and that equal variances across the denominations could be assumed ($p=0.67$). Multivariable linear regression models were run to estimate associations between the frequency of participation in religious activities and HbA1c, social support and HbA1c, and frequency of participation in religious activities and social support. Additionally, associations between the frequency of seeking care from TM practitioners and HbA1c were examined using a multivariable linear regression model. All regression models were adjusted for age, gender, duration of T2DM, education, and number of T2DM comorbidities.

Table 3.1 Demographic characteristics of individuals with T2DM who completed cognitive interviews at Narh-Bita hospital in Tema, Ghana

	English interviews (n=8)	Twi interviews (n=6)
Gender (% male)	50.00	16.67
Age in years: mean (SD)	61.63 (9.58)	60.50 (11.96)
Length of T2DM in years: mean (SD)	11.38 (8.73)	16.24 (11.06)

Table 3.2 Correlations among main study variables

	Kin composition	Household composition	Network density	Network size	Frequency of participation in religious activities	Frequency of seeking care from TM practitioners	Perceived diabetes social support (PDSS)	Diabetes-related stigma	HbA1c
Kin composition	-	0.28***	0.04	-0.12	-0.11	-0.05	0.13	-0.05	0.01
Household composition	-	-	0.11	-0.13	-0.09	0.05	0.12	-0.11	0.13
Network density	-	-	-	0.34***	0.07	0.02	0.25**	-0.17	-0.03
Network size	-	-	-	-	0.03	-0.09	0.30***	0.02	0.02
Frequency of participation in religious activities	-	-	-	-	-	0.13*	0.01	-0.05	-0.10
Frequency of seeking care from TM practitioners	-	-	-	-	-	-	-0.02	0.10	0.11
Perceived diabetes social support (PDSS)	-	-	-	-	-	-	-	-0.10	0.07
Diabetes-related stigma	-	-	-	-	-	-	-	-	0.08

*p<0.05; **p<0.01; ***p<0.001

CHAPTER 4

RESULTS

4.1 MANUSCRIPT 1

Social networks, perceived social support and HbA1c in individuals with type 2 diabetes mellitus in urban Ghana[3]

[3] Botchway M., Davis R.E., Merchant A.T., Appiah, L.T., Moore, S. To be submitted to *Social Science and Medicine.*

Abstract

Although links between social relationships and health are well established, few studies have concurrently examined whether compositional, structural, and functional dimensions of social networks affect blood glucose (HbA1c) control in low- and middle-income countries (LMICs). In these settings where informal social relationships are critical for access to resources, evaluating links between social network characteristics, social support, and HbA1c may provide clarity about important relationships that facilitate well-being among individuals with type 2 diabetes mellitus (T2DM). Between July and August 2018, we conducted a hospital-based, cross-sectional study of 254 non-institutionalized adults with T2DM and their social networks in Ghana, an LMIC. Multivariable linear regression models were used to estimate three types of associations: 1) associations between HbA1c and three social network characteristics (kin composition, household composition, and network density); 2) associations between social support and each network characteristic; and 3) the association between HbA1c and social support. We also examined gender differences in these associations and applied mediation techniques to determine if network characteristics operated through social support to affect HbA1c. Findings indicated that kin composition and household composition were significantly associated with social support. Neither social support nor social network characteristics were significantly related to HbA1c, and there were no gender differences in any of these associations. We highlight some potential reasons for the observed findings and provide recommendations for diabetes research and practice within LMICs like Ghana.

Introduction

It is well established that social networks are strongly associated with the management and control of type 2 diabetes mellitus (T2DM) (Kaplan & Hartwell, 1987; Miller & DiMatteo, 2013; Mondesir, White, Liese, & McLain, 2016; Strom & Egede, 2012; Vaccaro, Exebio, Zarini, & Huffman, 2014). Existing relationships with family members, friends and others in one's social network are channels through which social support is obtained to facilitate long-term care, enable blood glucose (HbA1c) control, and increase the quality of life among individuals with T2DM (Brinkhues et al., 2018; Connell, Fisher, & Houston, 1992; Garay-Sevilla et al., 1995; Miller & DiMatteo, 2013; Vaccaro et al., 2014; Vassilev, Rogers, Kennedy, & Koetsenruijter, 2014; Wiebe, Helgeson, & Berg, 2016). Although social relationships can provide many benefits, these relationships are sometimes detrimental for health outcomes. For instance, network members can hinder dietary behaviors or other disease management practices, and they may be unaware of the emotional needs of individuals with T2DM (Carter-Edwards, Skelly, Cagle, & Appel, 2004; Gallant, Spitze, & Prohaska, 2007; Kadirvelu, Sadasivan, & Ng, 2012; Vassilev et al., 2011). Many T2DM management behaviors related to food, exercise, and medication adherence occur outside of a clinical environment and require daily support or resource mobilization, therefore interactions with family and household members, which enable positive health behaviors, may shape one's health outcomes (Ciechanowski, Katon, & Russo, 2005; Fisher et al., 1998; Joensen et al., 2017; Knutsen et al., 2017; Vassilev et al., 2011). Among individuals with chronic heart disease or diabetes, denser networks have been instrumental in assisting with illness-related issues, such as providing comfort to ease anxiety, scheduling health appointments, and obtaining

prescriptions (Vassilev et al., 2013). Previous studies have suggested that compositional and structural dimensions of social networks, specifically kin composition, household composition, and network density, are critical for T2DM management and control (Knutsen et al., 2017; Patel et al., 2017; Reeves et al., 2014). Examining these social network dimensions and their links to the health of individuals with T2DM may provide insight on how important network members facilitate or hinder diabetes outcomes and important biomarkers such as HbA1c.

Most of the evidence about the influence of social networks on T2DM comes from research conducted in high-income countries (HICs); however, there is limited knowledge of how social networks affect T2DM management and control in low- and middle-income countries (LMICs) where the increased prevalence of diabetes is an emerging public health concern (Atun et al., 2017; Dagenais et al., 2016; Gill, 2014; Guariguata et al., 2014; Mbanya, Motala, Sobngwi, Assah, & Enoru, 2010). LMICs have higher T2DM prevalence rates than HICs, and, in 2017, global estimates revealed that 79% of adults with diabetes lived in LMICs (Dagenais et al., 2016; International Diabetes Federation, 2017; Mbanya et al., 2010; Utumatwishima, Chung, Bentley, Udahogora, & Sumner, 2018; World Health Organization, 2016). Ghana is one of those LMICs that has experienced a significant increase in T2DM-related hospital admissions, complications and deaths within the past 31 years (Sarfo-Kantanka et al., 2016). Country-specific studies with a predominant focus on two large urban cities indicate that the prevalence of T2DM increased from less than 1% to nearly 10% between the 1950s and 2012 (Danquah et al., 2012; de-Graft Aikins, Agyei-Mensah, & Agyemang, 2014). In 2013, there were at least 440,000 Ghanaian adults between the ages of 20 and 79 who had T2DM, and this

number is expected to rise to 819,000 by 2035 (Guariguata et al., 2014). A recent meta-analysis of diabetes studies in Ghana indicated that the disease prevalence among adults is 6.5% (Asamoah-Boaheng, Sarfo-Kantanka, Tuffour, Eghan, & Mbanya, 2018).

The increasing T2DM burden in Ghana is worrisome for several reasons. First, the absence of functional national policies for chronic diseases, including T2DM, has delayed a comprehensive, governmental approach to address the increasing disease burden (Bosu 2012, de-Graft Aikins et al., 2014). These limitations in health infrastructure and government resources place nearly all the responsibility for disease management on individuals with T2DM, their families, friends, and communities (de-Graft Aikins et al., 2010). Secondly, T2DM management in Ghana is expensive regardless of socio-economic status (de-Graft Aikins et al., 2014). When faced with these expenses, individuals with T2DM may be compelled to delay or neglect certain management strategies with potentially negative implications for their wellbeing. Thirdly, Ghana has standard treatment guidelines for diabetes (Ministry of Health, Ghana, 2010), but there are concerns about the comprehensiveness, clarity, dissemination, and implementation of the guidelines (Owolabi et al., 2018). As the country's older adult population is rapidly growing and at a higher risk for T2DM, traditional family support systems are simultaneously collapsing or changing because of Ghana's weak economy, urbanization, and changes in family priorities with a greater focus on the nuclear family and reduced financial support for older relatives (Aboderin, 2004; Kpessa-Whyte, 2018; Mba, 2010). In certain instances, dependence on family support for disease management has led to strained relationships (Aboderin, 2004; Addai, Opoku-Agyeman, & Amanfu, 2014; de-Graft Aikins, 2006; Tagoe, 2012). However, for chronic conditions like T2DM,

research that examines the characteristics of informal social networks that matter for HbA1c control among Ghanaians or the availability of health-related social support through such networks is sparse.

Within an LMIC context, informal social networks play a significant role in improving health outcomes and providing access to medical care and health-related resources (Perkins, Subramanian, & Christakis, 2015). These networks are crucial as many low-resource settings, like Ghana, experience limitations in health services and infrastructural challenges associated with the timely provision of formal social support (Addai et al., 2014; Edmonds, Hruschka, Bernard, & Sibley, 2012; Westaway, Seager, Rheeder, & Van Zyl, 2005). Individuals in these settings may naturally depend on their social relationships for support that is not readily available through more formalized public structures. For instance, rural Ghanaians who become ill and need support often seek assistance from others, particularly friends, who have more resources (MacLean, 2011).

In LMICs, there are some associations between social support, T2DM management and glycemic control (Gomes-Villas Boas, Foss, Freitas, & Pace, 2012; Lino, Portela, Camacho, Atie, & Lima, 2013; Odume, Ofoegbu, Aniwada, & Okechukwu, 2015; Westaway et al., 2005). While these findings provide awareness of diabetes-related social support as a functional dimension that emanates from social networks, studies in LMIC settings have often neglected an assessment of social networks as fundamentally distinct components with potentially unique contributions to HbA1c control. Consequently, there is limited information about how compositional or structural dimensions of social networks affect HbA1c. Berkman and colleagues' (2000)

conceptualization of the pathway from social networks through social support to health outcomes provides a useful framework for evaluating social networks and social support as separate entities that may affect HbA1c. A network-based approach that evaluates compositional and structural aspects of social relationships, in addition to social support, can provide more insight on how social networks operate among those with T2DM. Concurrently examining the important but unique contributions of these various components can elucidate essential factors for T2DM management that are beyond the capacity of affected individuals but are distinct from clinical support services. Adopting this approach to examine HbA1c control can increase our understanding of whether informal social networks affect T2DM outcomes through the provision of social support within LMICs.

Consistent with findings from the broader health-related literature, T2DM-specific studies have shown that there are often gender differences in the associations between social relationships and health (Connell et al., 1992; Eriksson & Rosenqvist, 1993; Kacerovsky-Bielesz et al., 2009; Kaplan & Hartwell, 1987; Mondesir et al., 2016). These gender differences may be a function of the types of networks in which women and men are embedded as well as the contexts in which diabetes is managed (Mondesir et al., 2016); however, there is mixed evidence for these associations. For instance, one study indicated that higher social support is linked to lower HbA1c among men but not women (Connell et al., 1992), while another study identified positive associations between social support and Hba1c control among women, but not men (Mondesir et al., 2016). Other studies have also reported conflicting findings regarding the types of social support that are important for HbA1c control among men and women (Eriksson &

Rosenqvist, 1993; Kacerovsky-Bielesz et al., 2009). There is even less evidence for the gender-related effects of structural aspects of social relationships, for example network size, on T2DM control (Kaplan & Hartwell, 1987). Most of these studies have been conducted in HICs, but contextual and structural factors that are linked to gender differences in health and access to resources may vary across countries and regions (Hosseinpoor et al., 2012; Moyer et al., 2014; Osamor & Grady, 2016). Consequently, research findings on gender, social networks, and HbA1c in HICs may be unique to those settings. Identifying whether gender matters for the effects of social relationships on HbA1c in an LMIC context may provide direction for developing tailored intervention strategies among those with T2DM.

To determine the influence of social networks on HbA1c control in an LMIC context, we examined compositional, structural, and functional dimensions of social networks among adults with T2DM in urban Ghana. First, we investigated associations between those structural components or network characteristics (kin composition, household composition and network density), social support, and HbA1c. Secondly, we examined gender differences in associations between network characteristics, social support and HbA1c. Thirdly, we estimated the indirect effect (via social support) of each network characteristic on HbA1c, as presented in Figure 4.1. These investigations may provide greater insight about the pathways through which social networks operate and whether important differences exist for Ghanaian men and women with T2DM.

Methods

Participants

We collected data through a cross-sectional survey of 254 noninstitutionalized individuals with T2DM conducted between July and August 2018 at the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana. Eligible study participants were more than 18 years old, had been diagnosed with T2DM for at least a year, and spoke English or Twi, which were two predominant languages in the Kumasi area. To accommodate the nature of patient flow, research staff manually generated a daily list of eligible study participants by screening medical records of existing patients, who were present for a clinical appointment, and recording the names and gender of those whose records showed they had T2DM for at least one year.

Data Collection

Patient screening and data collection activities occurred at KATH. A nurse on duty made a general announcement about the study to routinely scheduled patients in the waiting area. Potential participants, who had been identified through the screening process, were approached by one of six trained, bilingual research staff members and provided with more details about the study. Research staff completed the process for verbal and informed written consent in English or Twi with eligible and interested participants, and a nurse at the clinic assessed participants' HbA1c levels. In a private setting at the hospital, research staff orally administered an approximately 40-minute survey in each participant's preferred language using a paper-based questionnaire that was available in English and in Twi. Each participant received a post-incentive of 15 Ghana cedis (approximately $3.4) for completing the survey. The study was approved by

the Institutional Review Board at the University of South Carolina and the Committee on Human Research, Publication and Ethics for the Kwame Nkrumah University of Science and Technology and KATH.

Measures

Study participants verified their age and disease duration and provided information on health insurance coverage, comorbidities such as stroke, family history of diabetes, social support, and demographic characteristics.

HbA1c

An SD BIOSENSOR, standard A1cCare Analyzer and test kits (SD A1cCare Analyser, n.d.) were used to measure patients' HbA1c levels, and the raw values were treated as continuous data for analytical purposes. Assessments were successfully conducted for 234 participants.

Network size

Two name generator questions were used to identify individuals (alters) within study participants' social networks. For the first question, participants named a maximum of three people with whom they discussed important matters. For the second question, they named a maximum of three people who assisted them with household tasks. Network size referred to the total number of named alters that each participant identified through the name generators and ranged from 0-6.

Kin Composition

Kin composition was assessed by asking participants to identify their relationship with each named alter in their network and indicate if the alter was a spouse or an unmarried partner, child, other relative, friend or other social connection. Kin composition was then calculated as a proportion of the total number of alters who were identified as spouses, children, or other relatives. Kin composition ranged from 0 to 1, and higher proportions indicated that most of the alters were family members.

Household Composition

Household composition was assessed by asking participants to indicate if they currently lived with any of the named alters. This variable was calculated as the proportion of the number of alters who lived with each participant. Household composition ranged from 0 to 1, with higher proportions revealing that most alters were household members.

Network Density

Network density was measured by asking study participants to indicate whether named alters within their networks had relationships with each other as friends, family members or some other type of connection. Binary responses of yes or no for each pair of alters in each participant's network were used to calculate network density using the formula:

$$\textit{Network density} = \#\ \textit{of ties present} / [(n(n-1))/2]$$

where # *of ties present* referred to the total number of connections among alters in the network and *n* was the network size (Valente, 2010). Network density ranged from 0 to 1,

and higher proportions indicated that most alters had some type of connection to each other.

Social support

We measured perceived diabetes social support (PDSS) using 12 items from the emotional/informational support subscale and the tangible (instrumental) support subscale from the Medical Outcomes Study Social Support Survey (MOS-SSS)(Al-Dwaikat & Hall, 2017; Sherbourne & Stewart, 1991) and one item created by the study team. MOS-SSS is one of the most commonly used measure of social support for diabetes research (Al-Dwaikat & Hall, 2017), and it assesses the frequency with which respondents have access to different types of support. Since we were interested in capturing assistance that came from informal social networks, the 12 MOS-SSS scale items were modified to reflect access to diabetes-related support outside of a hospital setting. For example, an original emotional support item, "How often is each of the following kinds of support available to you if you need it: Someone you can count on to listen to you when you need to talk," was modified to "Outside of a clinic environment, how often do you have access to someone who you can count on to listen to you when you need to talk about your diabetes?" All MOS-SSS items used a 5-point Likert scale with response options that range from "none of the time" (=1) to "all of the time" (=5). An additional item on financial support was added to the instrumental support subscale, as previous findings from research in Ghana have suggested that financial support for health purposes is often lacking from social networks, particularly when such networks consist primarily of family members (Aboderin, 2004; de-Graft Aikins, 2006; MacLean, 2011). All 13 PDSS items were combined to compute an average score for support, with

higher scores indicating higher social support. The PDSS scale demonstrated high internal consistency for the study sample (α=0.87).

Covariates

We examined the following participant characteristics as covariates: age in years; gender (male or female); education (0-6 years of education, completed junior secondary school [JSS], completed senior secondary school [SSS] or higher); number of self-reported, T2DM comorbidities; and duration of T2DM in years (time since diagnosis in years). In all models, we controlled for network size as it could confound our network characteristics of interest.

Analysis

All analyses were conducted using SAS® 9.4 software (SAS Institute Inc., 2013). Univariate and bivariate analyses were conducted to better understand the data distributions of the sample. Next, we used multivariable linear regression models to estimate three types of associations: 1) associations between HbA1c and each social network characteristic separately (kin composition, household composition, and network density); 2) associations between PDSS and each social network characteristic separately; and 3) the association between PDSS and HbA1c. For each association, we ran crude models, partially adjusted models (including only age, gender, and duration of T2DM as covariates), and fully adjusted models, which included all covariates (age, gender, duration of T2DM, T2DM comorbidities, and level of education). Although we measured participants' monthly income as a potential confounder, we did not include that variable in the final analyses because it was moderately associated with education (r=0.40, p

<0.0001). Additionally, we had more complete information on education in comparison to income data.

We also examined gender differences in the associations among social network characteristics, social support and HbA1c. First, we tested for interactions between participants' gender and each social network characteristic in three fully adjusted, linear regression models with HbA1c as the dependent variable. Secondly, we tested for interactions between gender and social network characteristics in three fully adjusted, linear regression models with PDSS as the dependent variable. Finally, we tested for interactions between gender and social support in a fully adjusted, linear regression model with HBA1c as the dependent variable. Results from these models provided evidence for whether there was a need to further stratify the analyses by gender.

We then applied a mediation approach to estimate the indirect effect of each social network characteristic (via social support) on HbA1c. Mediation analyses require that potential confounders must be considered and included when examining associations between the exposure, the mediator, and the outcome (Valeri & Vanderweele, 2013; VanderWeele, 2016). In this study, the exposure variables were the three network characteristics, the mediator was social support, and the outcome was HbA1c. For social support to be considered a mediator, there must be a significant association between a network characteristic and social support as well as a significant association between social support and HbA1c. To test for mediation, we used a SAS macro that allowed for exposure-mediator interactions, and we adjusted for all covariates, while applying the embedded bootstrapping option to generate 1000 bootstrap samples to obtain standard

errors and confidence intervals (Valeri & Vanderweele, 2013). We used an alpha value of 0.05 for all statistical analyses.

Results

The clinical and demographic characteristics of the sample are presented in Table 4.1. Participants' ages ranged from 37-96 years, and approximately 59% of the sample (n=151) was more than 60 years old. All participants had some form of health insurance at the time of data collection, approximately 59% of them were female, and 92.5% (n=235) lived in multi-person households. Nearly 81% (n=205) of them lived in Kumasi, and 82.3% (n=209) identified as being of Akan ethnicity. On average, participants had lived with T2DM for over a decade with a range of 1-50 years, and 69.3% (n=176) had a family history of diabetes. Nearly 76% (n=192) of the sample reported having high blood pressure (hypertension), 3.2% (n=8) reported a heart condition, 3.2% (n=8) reported a previous diagnosis of tuberculosis, 5.9% (n=15) reported having a stroke, and one participant identified as HIV positive. The mean HbA1c was 9.22, and it ranged from 4.1-14.7. Approximately 75% of participants (n=176) had an HbA1c reading that was greater than 7%, indicating poor glycemic control. They reported that high levels of social support were often available from their network connections as the average PDSS score was 3.53 (1-5). Patients' networks had a high degree of interconnectivity and primarily consisted of family members, with a mean density score of 0.94 and a mean kin composition score of 0.80. The mean household composition score was 0.56. There were no significant gender differences in the average values for HbA1c, age, PDSS score, diabetes duration and each social network characteristics. In comparison to men, women

had significantly more T2DM comorbidities (p=0.01, t=-2.50), and they were less likely to be married (X^2 (1, n=254) =60.80, p <0.0001). Gender was also significantly associated with education, X^2 (2, n=254) =38.32, p <0.0001; monthly income, X^2 (2, n=201) =14.77, p=0.001; and work status, X^2 (3, n=254) =41.43, p <0.0001.

In the partially and fully adjusted analyses, none of the social network characteristics were significantly associated with HbA1c (Table 4.2). Increased social support was associated with increased HbA1c, and this association approached statistical significance (β =0.25, p=0.06). Results from partially adjusted models indicated that kin composition (p=0.01), household composition (p=0.01), and network density (p=0.04) were each significantly associated with PDSS, the mediator variable (Table 4.3). In the fully adjusted models, these relationships remained significant for kin composition (p=0.01) and household composition (p=0.01), but network density was no longer significantly associated with PDSS (p=0.05). There were no significant interactions with gender when associations between social network characteristics and PDSS and the association between PDSS and HbA1c were tested. There was also no significant interaction with gender when examining the associations between social network characteristics and HbA1c, therefore the overall analyses were not stratified by gender.

For the two exposure variables (kin composition and household composition) that were positively associated with the mediator (PDSS), bootstrap estimates were used to determine whether these exposure variables, PDSS and HbA1c were linked through a mediating pathway (Table 4.4). Although not significant, the total effect of kin composition and the total effect of household composition on HbA1c were both positive.

The direct and indirect effects of these network characteristics on HbA1c were small and not significant.

Discussion

This study examined associations between social network characteristics (kin composition, household composition and network density), social support, and HbA1c as well as gender differences in those associations. It also assessed the indirect effects of each network characteristic on HbA1c among individuals with T2DM in Ghana. Cross-sectional data, mainly from HICs, indicate that social networks can operate through psychosocial mechanisms, such as social support, to influence health (Benson, 2012; Chung, Jeon, & Song, 2016); however, we found contrary results. Specifically, the current study observed that kin composition and household composition were positively associated with social support but were not associated with HbA1c either directly or indirectly through social support. There was a weak positive association between social support and HbA1c. Additionally, there were no gender differences in any of these associations. The relationship between support and HbA1c may change based on how support is measured, with multidimensional measures potentially being better predictors of HbA1c (Stopford, Winkley, & Ismail, 2013). However, using a multidimensional measure of PDSS in the current study did not yield a significant association between social support and HbA1c. There are mixed findings about the relationship between social support and HbA1c (Stopford et al., 2013). While some studies have shown that support and Hba1c are significantly associated (Okura, Heisler, & Langa, 2009; Whittemore, D'Eramo Melkus, & Grey, 2005), others have found no association between

them (Chew, Khoo, & Chia, 2015; Gao et al., 2013; Westaway et al., 2005). Although the focus was not on diabetes, a study of a nationally representative sample of older Ghanaian adults has also revealed that perceived social support is not significantly linked to the likelihood of better health outcomes (Ayernor, 2016).

There are some possible explanations for why a significant association between support and improved HbA1c was not observed among adults with T2DM in Kumasi, Ghana. First, social support's effect on HbA1c may not be direct; instead, it could operate through other pathways. For instance, social support indirectly but significantly affects HbA1c control through self-efficacy and self-care behaviors such as medication adherence and exercise (Fortmann, Gallo, & Philis-Tsimikas, 2011; Gao et al., 2013; Osborn & Egede, 2010; Shao, Liang, Shi, Wan, & Yu, 2017). Since we did not measure those variables, we were unable to examine these relationships within our sample. Secondly, participants' satisfaction with social support or its perceived quality, rather than its availability, may be more important for HbA1c control. At least one study has shown that social support satisfaction is significantly linked to better HbA1c control in women but not in men (Kaplan & Hartwell, 1987). Furthermore, some studies that examined the direct relationship between social support and HbA1c and found significant associations used a nationally representative sample, recruited women enrolled in a coaching intervention program and accounted for professional support (Okura et al., 2009; Whittemore et al., 2005). These approaches vary from what was used in the current study and may partially account for the differences observed in the relationship between support and Hba1c.

In this study, higher levels of support were associated with poorer HbA1c although the association was small and not significant. As others have suggested (Connell et al., 1992; Stopford et al., 2013), individuals may seek more social support as HbA1c control worsens and the number of years of living with T2DM increases. This support may be crucial because T2DM complications or comorbidities that develop may make disease management more challenging over time. On average, our study participants lived with T2DM for 13.14 years, nearly 76% of them had high blood pressure, and some reported having at least two other health conditions in addition to T2DM. Therefore, it is plausible that these participants may have sought more social support to address various health-related challenges that were contributing to poor HbA1c control, but in a cross-sectional study this may manifest as a positive association between support and HbA1c. Future longitudinal studies can examine the links between social support and HbA1c among people with T2DM to determine the trends over time and assess the potential influence of diabetes comorbidities if and when they develop.

Study results revealed that as kin composition and household composition increased, levels of support also increased. These findings are consistent with studies, mainly from HICs, that have identified family and household members as important predictors of increased social support (Chung et al., 2016; Joensen et al., 2017; Kana 'Iaupuni, Donato, Thompson-Colón, & Stainback, 2005). When considering that traditional support systems in Ghana are changing with potentially less support available, especially for older adults (Aboderin, 2004; Kpessa-Whyte, 2018), it is interesting to note the high levels of social support reported in the current study. There is evidence that patrilineal ethnicities in Ghana are more likely to provide support to older adults when

compared to matrilineal ethnicities such as the Akan ethnic group (Ayernor, 2016), but this is in contrast with the results from the current study, in which the majority of participants are Akan and lived in Kumasi. Links between ethnicity systems and perceived support levels may be irrelevant among these urban-dwelling study participants, but perhaps the ability of individuals with T2DM to also provide support to network members may be a more distinguishing feature of the link between these network characteristics, social support, and potentially controlled HbA1c. Further research may provide insights on the value of support reciprocity for better T2DM outcomes.

It is plausible that kin composition, household composition, and network density operate through other critical psychosocial mechanisms, other than social support, to affect HbA1c. This could account for the lack of significant associations between any of the network characteristics and HbA1c. For example, social engagement, which refers to interactions with others through participation in activities (Berkman, Glass, Brissette, & Seeman, 2000), may be a more relevant mechanism through which social network characteristics affect HbA1c in our sample. At least one study in Ashanti Region, Ghana, has revealed that participation in social events is significantly associated with improved well-being among older adults (Gyasi, Phillips, & Abass, 2018). Findings from other countries suggest that social engagement is more important than social support, especially among older adults (Ashida & Heaney, 2008; Yokobayashi et al., 2017). Social engagement is an enriching experience that increases a sense of personal value and relevance in one's social context, and it is strongly linked to better health outcomes (Berkman et al., 2000; Krueger et al., 2009; Shibayama, Noguchi, Takahashi, & Tamiya,

2018; Umberson, Crosnoe, & Reczek, 2010). In the Ashanti region, funerals are considered as culturally significant, social events (Arhin, 1994; Mazzucato, 2008), and attendance at such events may provide opportunities for personally meaningful engagement and a sense of belonging within the community. Our study participants were mainly from this region, and at least 65% of them (n=165) were 60 years or older. For them, regularly attending or contributing to social events could increase connectedness to social ties and reduce worry about disease management as individuals are occupied with various roles. Future studies should consider social engagement as a psychosocial mechanism that may potentially influence T2DM outcomes in Ghana.

In the current study, there were no significant gender differences when examining associations between social network characteristics, social support and HbA1c. Previous studies, mainly conducted in the U.S., have reported mixed findings about these associations, particularly with respect to the varying effects of social support among women and men (Connell et al., 1992; Mondesir et al., 2016). Findings on the links between social network characteristics and T2DM outcomes among women and men are also scarce (Kaplan & Hartwell, 1987). Resources and support that come from other household or family members may require shared decision-making processes. In many LMICs, cultural and structural norms that shape gender roles and give men and women different levels of autonomy for healthcare decision making are distinct from expressions of independence and self-identity that are more predominant in Western cultures (Osamor & Grady, 2016). The level of decision-making autonomy, coupled with varying gender roles in Ghana, may be important factors to consider in future research as they may help identify more nuanced effects of support and social network characteristics on HbA1c

among women and men with T2DM. At least one study in Ghana's Ashanti region reported gendered differences in network types and social support, with women receiving more social support than men (Gyasi et al., 2018). Although this study and ours were both conducted in the same region, different measures of social network characteristics and social support were used and potentially affected the findings. Additionally, the previous study included rural residents and focused on adults who were 50 years or older. Future studies that generate comparative data from other locations in Ghana, as well from different LMICs and HICs, will provide more clarity about how social networks function and their potential effects on HbA1c or other T2DM outcomes.

The results of this study have implications for future research. Firstly, they suggest that the Ghanaian context may have changed the roles of social networks or the effects of social support, which is why our observed associations among network characteristics, social support and HbA1c are slightly different than those found in HICs. For instance, providing more social support may improve health outcomes among Ghanaians adults with T2DM, but further research is needed to determine if social support operates through indirect mechanisms to affect HbA1c control in this population. Secondly, we observed links between social network characteristics and social support that mirrored evidence from previous studies in HICs. While this finding suggests that informal social networks may be relevant for health outcomes among urban, Ghanaian populations with T2DM, the way in which those networks are influential needs additional investigation. For example, social support from health professionals or even peer groups, together with informal support, may be better predictors of improved HbA1c as previous research has identified their potentially vital contributions for T2DM management

(Heisler, 2007; Rosland et al., 2008). Further research may identify other dimensions of structural and functional aspects of social relationships that matter for diabetes outcomes in countries like Ghana.

Study limitations

Although this study has revealed some important findings about social relationships and HbA1c in an LMIC context, it has limitations. As other have indicated (Ayernor, 2016; Moore, Prybutok, Ta, & Amey, 2018; Perkins et al., 2015), cross-sectional data impedes any establishment of causality and limits the ability to obtain a comprehensive understanding of network mechanisms, especially as social relationships and disease progression evolve over time. Additionally, bidirectional relationships between health, network characteristics, and social support cannot be estimated using cross-sectional data. By limiting the number of alters that study participants could identify, we artificially restricted social networks in a way that may not fully capture variations in the structural nature of their social relationships. A small sample size and the absence of data on health behaviors, such as diet and exercise, that are crucial for T2DM management, may have also affected the nature of our results. Furthermore, our sample of urban residents may have needs and values that are unique from those of others living elsewhere in Ghana or in other LMICs, particularly in rural areas. Although convenience sampling was necessary because of the practical constraints of the clinic operation, using this method may have limited the generalizability of the findings. Additionally, study participants may have come to the hospital because they had some level of support. Individuals with T2DM who are very sick or who could not afford to

travel to the hospital may potentially differ from study participants in ways that shape how social relationships, social support and HbA1c are linked.

Conclusions

To date, this is one of the few studies to investigate the links between social relationships and HbA1c within an LMIC context by concurrently examining structural and functional aspects of social networks. Findings indicated that higher proportions of family and household members in participants' social networks were significantly linked to higher levels of social support. Neither social network characteristics nor social support were significantly related to HbA1c among study participants in Ghana. It is likely that other mechanisms are more relevant for associations between social relationships and HbA1c. Additionally, there were no gender differences in the associations between social network characteristics, social support and HbA1c. Understanding how informal social networks enable better health outcomes among people with T2DM who live in LMICs requires a broader exploration of varied dimensions of social relationships and disease progression over time.

Declarations of Interest

None.

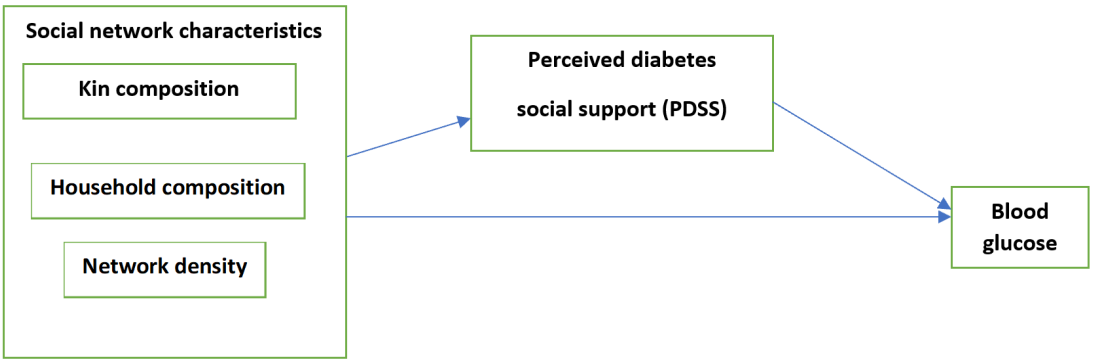

Figure 4.1 Conceptual model of relationships among social network characteristics, social support and blood glucose

Table 4.1 General and social network characteristics of T2DM patients in Kumasi, Ghana, full sample and by gender

	Full sample (n=254)	**Women (n=151)**	**Men (n=103)**
Variable			
Age in years: mean (SD)	62.90 (10.20)	63.23 (10.26)	62.42 (10.13)
Married (%)	57.09	37.09	86.41
Education (%)			
0-6 years of education	35.04	45.70	19.42
Completed junior secondary school (middle school)	38.19	41.06	33.98
Completed senior secondary school (high school) or higher	26.77	13.25	46.60
Monthly income (%)			
Less than 200 Ghana cedis[a]	23.38	31.82	13.19
200-499 Ghana cedis	37.81	40.00	35.16
500 Ghana cedis or more	38.81	28.18	51.65
Work status (%)			
Employed full-time 1	32.28	27.15	39.81
Unemployed 2	26.38	37.75	9.71
Retired 3	21.26	11.26	35.92
Other 4	20.08	23.84	14.56
T2DM duration in years: mean (SD)	13.14 (7.10)	12.89 (6.90)	13.50 (7.39)
Number of T2DM comorbidities: mean (SD)	0.88 (0.61)	0.96 (0.58)	0.77 (0.64)
HbA1c %: mean (SD)	9.22 (2.60)	9.27 (2.57)	9.14 (2.66)
Social network characteristics: mean (SD)			
Network size	4.08 (1.31)	4.05 (1.34)	4.12 (1.28)
Kin composition	0.80 (0.25)	0.81 (0.26)	0.79 (0.25)
Household composition	0.56 (0.32)	0.56 (0.33)	0.57 (0.31)
Network density	0.94 (0.21)	0.96 (0.17)	0.90 (0.25)
Perceived diabetes social support: mean (SD)	3.53 (1.03)	3.45 (1.08)	3.66 (0.96)
[a]At the time of the study, $1 was approximately equivalent to 4.4 Ghana cedis			

Table 4.2 Results of linear regression models estimating the influence of social network characteristics and perceived diabetes social support on HbA1c

	Partially adjusted models β (SE)				**Fully adjusted models β (SE)**			
Dependent variable: HbA1c	**Model 1 (n=228)**	**Model 2 (n=227)**	**Model 3 (n=228)**	**Model 4 (n=229)**	**Model 1 (n=228)**	**Model 2 (n=227)**	**Model 3 (n=228)**	**Model 4 (n=229)**
Social network characteristics								
Kin composition	0.44 (0.69)	–	–	–	0.54 (0.70)	–	–	–
Household composition	–	0.97 (0.56)	–	–	–	0.98 (0.56)	–	–
Network density	–	–	-0.59 (0.88)	–	–	–	-0.48 (0.89)	–
Network size	0.10 (0.13)	0.11 (0.13)	0.12 (0.14)		0.11 (0.13)	0.12 (0.13)	0.12 (0.14)	–
Perceived diabetes social support (PDSS)	–	–	–	0.24 (0.17)	–	–	–	0.25 (0.17)
Age (years)	-0.05 (0.02)**	-0.05 (0.02)**	-0.05 (0.02)**	-0.05 (0.02)**	-0.05 (0.02)**	-0.05 (0.02)*	-0.05 (0.02)**	-0.05 (0.02)**
Gender								
Female	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Male	-0.15 (0.35)	-0.19 (0.35)	-0.19 (0.36)	-0.23 (0.35)	-0.32 (0.39)	-0.33 (0.39)	-0.33 (0.39)	-0.39 (0.39)
T2DM duration (years)	0.04 (0.03)	0.04 (0.03)	0.04 (0.03)	0.04 (0.02)	0.04 (0.03)	0.04 (0.03)	0.04 (0.03)	0.04 (0.02)
Education								
0-6 years of education	–	–	–	–	Referent	Referent	Referent	Referent
Completed junior secondary school (middle school)	–	–	–	–	-0.02 (0.42)	-0.02 (0.41)	-0.05 (0.42)	-0.11 (0.42)
Completed senior secondary school (high school) or higher	–	–	–	–	0.55 (0.49)	0.49 (0.48)	0.47 (0.48)	0.47 (0.48)
Number of T2DM comorbidities					0.08 (0.29)	0.11 (0.29)	0.10 (0.29)	0.05 (0.29)
R^2	0.04	0.05	0.04	0.03	0.05	0.06	0.05	0.05
Model p-value	0.10	0.03	0.10	0.05	0.20	0.10	0.22	0.09

*p<0.05; **p<0.01; ***p<0.001

Table 4.3 Results of linear regression models estimating the influence of social network characteristics on perceived diabetes social support

	Partially adjusted models β (SE)			**Fully adjusted models β (SE)**		
Dependent variable: Perceived diabetes social support (PDSS)	**Model 1 (n=247)**	**Model 2 (n=246)**	**Model 3 (n=247)**	**Model 1 (n=247)**	**Model 2 (n=246)**	**Model 3 (n=247)**
Social network characteristics						
Kin composition	0.69 (0.25)*	–	–	0.71 (0.25)*	–	–
Household composition	–	0.50 (0.20)*	–	–	0.53 (0.20)*	–
Network density	–	–	0.66 (0.32)*	–	–	0.64 (0.32)
Network size	0.24 (0.05)***	0.23 (0.05)***	0.18 (0.05)***	0.23 (0.05)***	0.22 (0.05)***	0.18 (0.05)**
Gender						
Female	Referent	Referent	Referent	Referent	Referent	Referent
Male	0.19 (0.13)	0.17 (0.13)	0.22 (0.13)	0.20 (0.14)	0.21 (0.14)	0.24 (0.14)
T2DM duration (years)	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Education						
0-6 years of education	–	–	–	Referent	Referent	Referent
Completed junior secondary school (middle school)	–	–	–	0.28 (0.15)	0.24 (0.15)	0.22 (0.15)
Completed senior secondary school (high school) or higher	–	–	–	0.11 (0.17)	0.04 (0.17)	0.07 (0.17)
Number of T2DM comorbidities	–	–	–	0.16 (0.10)	0.19 (0.10)	0.18 (0.10)
R^2	0.12	0.11	0.11	0.14	0.13	0.13
Model p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

*p<0.05; **p<0.01; ***p<0.001

Table 4.4 Direct and indirect effects of kin composition and household composition on HbA1c

	Kin composition			Household composition		
Analysis	**β**	**SE**	**95% CI**	**β**	**SE**	**95% CI**
Natural direct effect	0.41	0.57	-0.74, 1.46	0.50	0.30	-0.07, 1.09
Natural indirect effect	0.04	0.08	-0.11, 0.21	0.02	0.04	-0.06, 0.12
Total effect	0.45	0.56	-0.69, 1.53	0.52	0.30	-0.05, 1.10

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4.2 MANUSCRIPT 2

Diabetes-related stigma: a cross-sectional study of its influence on social networks, perceived social support, and HbA1c in Kumasi, Ghana[4]

[4] Botchway M., Davis R.E., Merchant A.T., Appiah, L.T., Moore, S. To be submitted to *Diabetes Research & Clinical Practice.*

Abstract

Aims

We applied a social network approach to examine if three types of diabetes-related stigma (self-stigma, perceived and enacted stigma) moderated associations between social network characteristics (network size, kin composition, household composition, and network density), social support, and blood glucose (HbA1c) among Ghanaians with type 2 diabetes mellitus (T2DM).

Methods

Data were obtained through a cross-sectional survey of 254 adults at a diabetes clinic in Ghana that assessed adults' social networks, social support, and the frequency of three types of diabetes-related stigma.

Results

Self-stigma moderated associations between kin composition and social support when controlling for network size (β=-0.97, p= 0.004). Among study participants reporting low self-stigma, kin composition was positively associated with social support (β=1.29, $p<0.0001$), but this association was not found among those reporting moderate self-stigma. Network size was positively associated with social support among participants reporting both low and moderate self-stigma. None of the types of diabetes-related stigma moderated other associations among social networks, social support, and HbA1c.

Conclusions

Individuals with T2DM who report moderate self-stigma may have lower social support and potentially poor health. Additionally, larger social networks may be beneficial for individuals with T2DM in LMICs, and interventions that expand network resources may facilitate disease management.

Keywords: stigma, type 2 diabetes, social networks, social support, Ghana, LMICs

Introduction

Global estimates of increasing disease prevalence and related healthcare costs suggest that type 2 diabetes mellitus (T2DM) brings an enormous burden to many communities and health systems (Cho et al., 2018; Utumatwishima, Chung, Bentley, Udahogora, & Sumner, 2018). Among adults with T2DM, the micro- and macro-vascular complications, comorbidities, and the demands of disease management are often overwhelming and have been associated with debilitating psychosocial issues such as depression and anxiety (Ducat, Philipson, & Anderson, 2014; Karuranga & Duke, 2018). In Western contexts, diabetes-related stigma is a psychosocial challenge that diminishes access to resources, alters social interactions, and reduces individual capacity for disease management (Gredig & Bartelsen-Raemy, 2017; Schabert, Browne, Mosely, & Speight, 2013). However, the extent to which it affects diabetes management in low- and middle-income countries (LMICs), where the prevalence of diabetes is rapidly growing (Dagenais et al., 2016), remains unclear. Stigma can result in discrimination and stress, as well as exacerbate existing socioeconomic inequalities in LMICs that affect access to healthcare (Hatzenbuehler, Phelan, & Link, 2013; Person, Bartholomew, Gyapong, Addiss, & van den Borne, 2009; Peters et al., 2008), so it can potentially worsen health inequalities in these settings. Expanding LMIC research initiatives to identify the frequency and nature of diabetes-related stigma may be useful for planning and implementing appropriate interventions to mitigate its impact on health outcomes.

Weiss and colleagues (2006) describe health-related stigma as "a social process, experienced or anticipated, characterized by exclusion, rejection, blame, or devaluation" (p. 280). Others have indicated that health-related stigma intrinsically occurs within the

sphere of social relationships (Vassilev et al., 2011). The broader literature on stigma suggests that individuals who worry about being stigmatized may refuse to disclose their health condition or delay, reduce, or terminate medical treatment, leading to poor health outcomes (Earnshaw & Quinn, 2012; Person et al., 2009). A small but growing body of research from HICs indicates that people who feel stigmatized because of their T2DM report increased psychological distress, strained social relationships, social rejection, less social support, difficulty with disease management, and higher blood glucose (HbA1c) levels (Browne, Ventura, Mosely, & Speight, 2016; Gredig & Bartelsen-Raemy, 2017; Liu et al., 2017; Schabert et al., 2013). In LMICs, research on diabetes-related stigma is scarce, so there is limited insight regarding its effects on individuals with T2DM. Cultural context and social settings often shape identities, behaviors, and appearances that are considered as appropriate or normal; thus, social contexts influence what may be stigmatized or not over time (Keusch, Wilentz, & Kleinman, 2006; Link & Phelan, 2001; Yang, Thornicroft, Alvarado, Vega, & Link, 2014). These links between context and stigma suggest that examining culturally relevant characteristics, such as local perceptions of diabetes, may yield more relevant findings about the effects of stigma on disease management and HbA1c.

In Ghana, a qualitative study has explored how local perceptions of disease, poverty, and sociocultural factors are linked to diabetes-related stigma. The Ghana study revealed that some persons with uncontrolled diabetes experienced rapid weight loss, which was associated with HIV/AIDS in the rural communities where they lived (de-Graft Aikins, 2006). In social settings, study participants noted that there were often rumors that people with diabetes had HIV/AIDS or were involved in some type of

witchcraft (de-Graft Aikins, 2006). Study participants with diabetes did not have HIV/AIDS. However, they experienced HIV-related stigma and witchcraft stigma, which were entrenched in socially constructed representations of disease (de-Graft Aikins, 2006). Additionally, they coped with depression, loss of financial support from family, and social isolation (de-Graft Aikins, 2006). Although this study identified multidimensional and context-specific aspects of diabetes-related stigma (de-Graft Aikins, 2006), it did not extensively examine participants' social networks. Stigma can interfere with social relationships and deplete social support resources, which matter for T2DM management (Fisher et al., 1998; Hatzenbuehler et al., 2013). Therefore, adopting a social network approach to examine stigma among Ghanaians with T2DM may reveal whether stigma affects potentially important network features that facilitate HbA1c control. To our knowledge, no studies have examined links between diabetes-related stigma, social networks, and HbA1c within an LMIC or Ghanaian setting.

Studies, mainly conducted in HICs, show that dense social networks are associated with poor disease self-management (Reeves et al., 2014), more support from family and friends increases the likelihood of HbA1c monitoring (Rosland et al., 2008), and cohabitation with other adults, excluding one's partner, can increase diabetes distress (Joensen et al., 2017). These findings suggest that the extent to which family (kin composition) or household members (household composition) comprise a person's social network, as well as interconnectivity among one's network members (network density), are important structural and compositional characteristics of social networks that may influence T2DM management and control. Additionally, a larger network size is an important structural characteristic for reducing mortality risks among those with diabetes

(Loprinzi & Ford, 2018). In Ghana and other LMICs that lack adequate healthcare infrastructure (Addai, Opoku-Agyeman, & Amanfu, 2014; Perkins, Subramanian, & Christakis, 2015), social networks may facilitate an individual's primary access to social support, which, in turn, has been shown to improve T2DM management (Fisher et al., 1998). In such settings, what remains unclear is whether and how diabetes-related stigma affects individuals' social networks, the social support these networks may provide, or the ability to control HbA1c. Stigma and social support are important predictors of health outcomes, and the interrelationships of these factors have been established in HIV research (Li, Mo, Wu, & Lau, 2017). However, associations between stigma and social support, as well as their effects on HbA1c, have hardly been examined or situated within the sphere of social networks.

In HICs and LMICs, T2DM management strategies, such as dietary habits, often occur within a family or household context and involve resource mobilization and collective decision-making involving family or household members (Abdulrehman, Woith, Jenkins, Kossman, & Hunter, 2016; Fisher et al., 1998; Joensen et al., 2017). These social relationships can affect health through social support provision (Berkman, Glass, Brissette, & Seeman, 2000). Consequently, the potentially critical role that family or household members play in T2DM management warrants the inclusion of social network characteristics, while evaluating mechanisms that link social support, stigma, and HbA1c. The goal of this study was to apply a social network approach in examining how diabetes-related stigma may influence perceived social support and the management of HbA1c among adults with T2DM in Ghana. We hypothesized that individuals with T2DM who report higher levels of stigma will have poorer HbA1c control, and we were

interested in identifying the role of diabetes-related stigma as a moderator for two types of associations: 1) the association between social network characteristics (kin composition, household composition, and network density) and social support; and 2) the association between social support and HbA1c.

Subjects, materials and methods

Study design and population

Between July and August 2018, a cross-sectional survey was conducted with 254 patients at the diabetes clinic at the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana. Eligible patients were at least 18 years old, diagnosed with T2DM for at least one year, and fluent in English or Twi, which were two predominant languages within the patient population. Based on diabetes type and length of disease, a daily list of potentially eligible participants was generated by screening medical records of patients who were present for a clinical visit. Using this list, trained research staff approached patients in the waiting area of the diabetes clinic to determine their interests in the study and confirm their eligibility.

Data collection

Data were obtained through the administration of a paper-based questionnaire and HbA1c tests that were completed while study participants were waiting to see a physician. Participants provided verbal and written informed consent, and a nurse at the clinic measured their HbA1c levels. In a private setting at the clinic, research staff identified a participant's language preference and orally administered the questionnaire, which was available in English and Twi. Each participant received an incentive of 15

Ghana cedis (approximately $3.4) upon completion of the survey. Ethical approval was provided by the Institutional Review Board at the University of South Carolina and the Committee on Human Research, Publication and Ethics for the Kwame Nkrumah University of Science and Technology and KATH.

Measures

Prior to data collection, measures for social support and diabetes-related stigma were pretested through cognitive interviews with 14 Ghanaians with T2DM at another hospital.

HbA1c

HbA1c was assessed with an SD BIOSENSOR, standard A1cCare Analyzer and test kits (SD A1cCare Analyser, n.d.), and the raw values were treated as continuous data for analytical purposes. HbA1c values ranged from 4.1-14.7 for 234 individuals for whom the test was successfully conducted.

Diabetes-related stigma

Diabetes-related stigma was measured using 28 items, 16 of which were adapted from the 19-item, Type 2 Diabetes Stigma Assessment scale (DSAS-2), which consisted of three subscales and was originally developed in Australia (Browne et al., 2016). The study team developed seven items to expand on existing DSAS-2 items and five additional items based on previously published stigma research in Ghana and four other LMICs (de-Graft Aikins, 2006; Genberg et al., 2009; Person et al., 2009). For example, a DSAS-2 scale item asked if a person with T2DM was excluded from social occasions involving food or drink that others thought he or she should not have. One of the new

items asked if this type of restriction also occurred at home. Another item that was based on LMIC research asked, "how often do people mistake you for having HIV/AIDS because of your diabetes?" A 5-point Likert scale that ranged from "never" (=1) to "very often" (=5) was used to measure the frequency of participants' stigma-related experiences and perceptions. The diabetes-related stigma variable was computed to form a single scale score by averaging responses across all items, and it demonstrated high internal consistency (α=0.88). Higher scores on the diabetes-stigma scale indicated more frequent stigma. The treated differently subscale assessed enacted stigma (11 items; α=0.68), the blame and judgment subscale assessed perceived stigma (11 items; α=0.82), and the self-stigma subscale was a measure of internalized stigma (6 items; α=0.81).

Network size

Two name generator questions were used to identify individuals (alters) within study participants' social networks. For the first question, participants named a maximum of three people with whom they discussed important matters. For the second question, participants named a maximum of three people who assisted them with household tasks. Network size, which ranged from 0-6, referred to the total number of alters that each participant identified.

Kin Composition

Kin composition was assessed by asking participants to indicate if each alter was a spouse or an unmarried partner, child, other relative, friend, or some other connection. Kin composition was calculated by summing the number of alters that each participant identified as a spouse, child, or relative and then dividing this number by the total number

of unique alters mentioned by each participant. The final kin composition variable ranged from 0 to 1, with higher values indicating that most of the alters were family members.

Household Composition

Household composition was assessed by asking each participant to indicate if he or she currently lived with any of his or her named alters and then dividing the number of alters who lived with each participant by the total number of named alters. Household composition ranged from 0 to 1, with higher values indicating that most alters were household members.

Network Density

Network density was measured by asking each study participant to indicate whether named alters had relationships with each other as friends, family members, or some other type of connection using binary responses of "yes" or "no" for each alter-alter dyad in a person's network. These responses were used to calculate network density with the formula:

$$\textit{Network density} = \textit{\# of ties present} / [(n(n-1))/2]$$

where *# of ties present* referred to the total number of connections among alters in the network and *n* was the network size (Valente, 2010). The network density variable ranged from 0 to 1, with higher values indicating that most alters had some type of connection to each other.

Social support

Perceived diabetes social support (PDSS) was measured using eight items from the emotional/informational support subscale and four items from the tangible

(instrumental) support subscale from the Medical Outcomes Study Social Support Survey (MOS-SSS) (Sherbourne & Stewart, 1991). All 12 MOS-SSS items were modified to assess diabetes-related support outside of a clinical setting. Based on previous research in Ghana indicating that financial support for health purposes is often lacking from social networks, particularly family members (MacLean, 2011), an item about financial support was created by the study team and added to the instrumental support subscale. Participants were asked, "how often do you have access to someone who can help you pay for your diabetes medical expenses?" All items used the original MOS-SSS 5-point Likert scale ranging from "none of the time" (=1) to "all of the time" (=5). The average of responses to all 13 PDSS items was calculated to form a single scale score, and the PDSS scale demonstrated high internal consistency for the study sample (α=0.87).

Covariates

Participants reported various demographic characteristics, including ethnicity. The following characteristics were included as covariates: age in years; gender (male or female); education (0-6 years of education, completed junior secondary school [JSS], completed senior secondary school [SSS] or higher); number of self-reported, T2DM comorbidities; and duration of T2DM in years (time since diagnosis).

Analysis

All analyses were conducted using SAS® software (SAS Institute Inc., 2013). First, we ran descriptive and bivariate statistics to identify sample characteristics. As moderately significant correlation was observed between monthly income and education ($r=0.40$, $p<0.0001$), we excluded income from further statistical analyses because we had more complete data on education. To determine if there were any significant differences

among study participants based on diabetes-related stigma, the median value for stigma was used to stratify the sample into two groups: individuals with moderate stigma and those with low stigma. Differences between these groups were examined using Pearson chi-square tests for categorical variables and t-tests for continuous variables. Secondly, we ran three multivariable linear regression models to estimate the influence of three social network characteristics (kin composition, household composition, and network density) as predictors of social support (mediator). To examine the role of each type of stigma (perceived stigma, enacted stigma, and self-stigma) as a moderator, we ran additional models to evaluate the influence of each network characteristic on social support while including an interaction term for the network characteristic and each type of stigma in separate models. Network size is an important factor that affects other network characteristics and indicates the boundary of each network (Valente, 2010), therefore, we controlled for size in all models that included any of the three network characteristics as an independent variable. Thirdly, we used a multivariable linear regression model to estimate the influence of social support on HbA1c (outcome). We also ran additional models to examine the effect of each type of stigma as a moderator of the relationship between social support and HbA1c. We adjusted for age, gender, education, number of T2DM comorbidities, and duration of T2DM in all models, and those that included a statistically significant interaction term provided evidence for further stratifying the analyses. An alpha value of 0.05 was used for all statistical analyses.

Results

Sample characteristics are provided in Table 4.5. Approximately 75% of study participants (n=176) had an HbA1c reading that was greater than 7.0 %, indicating poor glycemic control. The average score for diabetes-related stigma was 1.40 (median = 1.31), and it ranged from 1-5 for all participants. On average, participants with low stigma were significantly older than those with moderate stigma (t=3.17, p=0.002). The average HbA1c value for those with low stigma was lower compared to the average HbA1c value for those with moderate stigma; however, this difference was not significant (t=-0.96, p=0.34). No other significant differences were observed when comparing individuals with moderate stigma to those with low stigma. In total, 252 study participants identified 1028 alters who helped with household tasks and with whom they discussed important matters. Two participants did not identify any alters. There were 814 family members within study participants' social networks, and most family members were participants' children (n=455). Among 129 study participants, all alters were family members.

Regression models indicated that kin composition (p=0.01) and household composition (p=0.01) were significantly associated with social support, while adjusting for diabetes-related, self-stigma (Table 4.6). Network density was not associated with social support (p=0.10). Fully adjusted analysis examining the effect of self-stigma as a moderator of the relationship between kin composition and social support showed a statistically significant interaction between kin composition and self-stigma (p=0.01). Self-stigma did not moderate the relationship between household composition and social support or between network density and social support.

To examine the significant interaction between kin composition and self-stigma, further analysis was stratified by low and moderate diabetes-related, self-stigma (Table 4.7). Fully adjusted models revealed that among study participants who reported low self-stigma, there was still a significant association between kin composition and social support ($p<0.0001$); however, this association was not observed among participants who reported moderate self-stigma. In both models, network size was positively associated with social support regardless of whether study participants reported moderate or low self-stigma. Neither perceived stigma nor enacted stigma moderated the associations between any of the network characteristics and social support. Additionally, social support did not have a significant association with HbA1c, and the different types of stigma did not moderate this association.

Discussion

In this study, we examined whether three types of diabetes-related stigma (perceived stigma, enacted stigma, and self-stigma) moderated associations between social network characteristics and perceived social support, or between perceived social support and HbA1c among Ghanaians with T2DM. Study participants' levels of diabetes-related self-stigma determined the extent to which kin composition was associated with perceived social support for disease management. Among those with low self-stigma, a higher proportion of family members in one's social network was positively associated with greater social support. The observation that family provides more support is consistent with research from HICs, which indicates that family members are among primary social connections through which social support is provided for adults with T1DM and T2DM (Coffman, 2008; Rad, Bakht, Feizi, & Mohebi, 2013). Perceived

social support may improve individuals' ability to adequately face challenges if there is some assurance that others are available to help them cope during various situations (Galvan, Davis, Banks, & Bing, 2008). Among family ties, information and caregiving responsibilities can be discussed and shared in a way that may facilitate access to important health resources. Although our findings show that family members are the most important source of T2DM social support among urban Ghanaians, previous studies in Ghana suggest that relying on family support for chronic disease management may result in an increased financial burden on the family and strained relationships among family members (de-Graft Aikins, 2006; Tagoe, 2012). In LMICs and HICs, family systems can be both supportive and inhibitive for diabetes management (Abdulrehman et al., 2016; BeLue et al., 2012; Fisher et al., 1998). Future social network studies can examine whether certain types of family members are more helpful for people with T2DM.

We did not observe any associations between kin composition and social support among participants who reported moderate levels of self-stigma. Higher levels of self-stigma—internalized feelings of shame, guilt, and negative attitudes towards oneself—can reduce self-efficacy and self-esteem such that affected individuals become withdrawn, depressed, and less likely to interact with existing but potentially supportive ties (Davison, Pennebaker, & Dickerson, 2000; Li et al., 2017; Ritsher & Phelan, 2004). Research in Japan has indicated that experiences of self-stigma affected the degree to which people with T2DM participated in social activities (Kato et al., 2016). Some people abandoned medication and diet adherence practices to maintain a certain persona and preserve social relationships, while others tried to avoid stigma by disconnecting

from others and becoming isolated (Kato et al., 2016). Other diabetes studies in HICs have revealed that those with the highest levels of self-stigma have low levels of social participation, and higher levels of perceived stigma are associated with reduced, perceived social support (Gredig & Bartelsen-Raemy, 2017; Kato et al., 2017). Taken together, these findings provide insights for the current study. It is plausible that Ghanaians with T2DM who reported moderate self-stigma may have become less outgoing or felt less deserving of assistance from others, thus leading to perceptions that social support had diminished. Self-stigma may change how individuals perceive themselves in comparison to others who lack the stigmatizing condition, as well as their interactions with others (Seo & Song, 2019), potentially resulting in adverse effects on existing, supportive relationships.

Based on findings from the present study, it is challenging to identify whether social interactions drive stigma, whether stigma shapes social interactions, or if there may be a cyclical relationship between these two factors among individuals with T2DM. Among Ghanaians who drastically lost weight because of poorly controlled diabetes, HIV-related stigma, caregiver burden, and extensive financial dependence contributed to family conflict and loss of support for diabetes management (de-Graft Aikins, 2006). These findings strongly suggest that stigma altered the nature of social relationships and interactions for Ghanaians with diabetes. Little is known about causal linkages between diabetes-related stigma and social interactions, and cross-sectional and longitudinal research in the U.S. has yielded mixed evidence about these linkages with respect to mental health (Link, Cullen, Struening, Shrout, & Dohrenwend, 1989; Mueller et al., 2006; Sibitz et al., 2011). Longitudinal studies in LMICs and HICs can examine how

both stigma and social interactions affect HbA1c, while increasing our understanding of contextual factors that affect these disease mechanisms over time.

Findings from this study also indicate that participants with larger social networks felt that they had greater availability of social support for T2DM management. This observation resonates with results from previous research in HICs, in which positive associations have been observed between network size and perceived social support (Seeman & Berkman, 1988). Among our study participants, the significant, positive association of network size with support, irrespective of levels of self-stigma, strongly suggests that compared to compositional characteristics of networks, size, as a structural characteristic, may be more important for support. Larger networks that include varied social ties can provide avenues for interactions with non-family members or distal social connections who may serve as additional sources of social support. Larger networks often provide access to diverse resources (Seeman & Berkman, 1988). Thus, individuals with T2DM who are connected to many network members may potentially obtain assistance with different health-related needs from a larger range of sources.

Diabetes-related stigma did not moderate the association between household composition and social support or the association between network density and social support. In the presence of stigma, there may be indirect mechanisms that link these network characteristics to support, however, evaluating those indirect mechanisms was beyond the scope of this study. Furthermore, self-stigma, which is one of the most well-studied concepts of stigma, is conceptually distinct from the other types of stigma (Hatzenbuehler et al., 2013), and research shows that each type has unique effects on mental health-related behaviors (Pattyn, Verhaeghe, Sercu, & Bracke, 2014). This

implies that there is potential for self-stigma, perceived and enacted stigma to also produce varying effects on social support and health outcomes, such that one type of stigma may be more relevant than others, as we observed. Additionally, social support was not significantly associated with HbA1c, and diabetes-related stigma was irrelevant for the relationship between social support and Hba1c in this study. While we anticipated its direct effect on HbA1c, social support may have operated through a buffering process, which considers the effects of stress on health outcomes and how support may mitigate those effects (Cohen & Wills, 1985). Future studies can evaluate if social support reduces the adverse effects of stress on HbA1c, especially among individuals with high diabetes-related self-stigma.

Although this study is novel in its application of a social network approach to examine the role of diabetes-related stigma within an LMIC context, it has certain limitations. First, our cross-sectional study design limited the ability to draw causal conclusions about social networks and diabetes-related stigma. Secondly, social networks and diabetes-related stigma can change over time and have varying effects on individuals with T2DM as their health conditions also evolve over time. Longitudinal research will be useful in identifying these changes and how they impact HbA1c control among Ghanaians. Thirdly, study participants could only list a maximum of six alters, which limited our ability to fully capture the nature of their social networks. Fourthly, study participants reported moderate or low diabetes-related stigma, but these levels may not be reflective of all Ghanaians with T2DM. Additionally, the sampling approach limits the generalizability of these findings to other individuals with T2DM. Finally, further

research is necessary to more fully examine the psychometric properties of the scale that was used in this study, as well as its appropriateness for use in other settings.

Diabetes-related stigma and its association with existing social relationships is a complex phenomenon that has been understudied in LMICs like Ghana, but it may have negative and potentially long-lasting health effects among people with T2DM. This study has demonstrated that in Ghana, the relationship between perceived social support and social network characteristics, like kin composition, is not static but depends on the type and frequency of stigma experiences and perceptions. Individuals with T2DM who reported moderate diabetes-related, self-stigma may have lacked adequate social support for disease management. Additionally, larger social networks were significantly associated with higher, social support, and future network interventions that connect people with T2DM to institutional resources, such as diabetes peer support groups, may be useful in providing additional health education and emotional support. Such interventions must also consider educating health professionals, people with T2DM, and their existing ties about diabetes-related stigma. Future LMIC research can examine how diabetes-related stigma, as a potential driver of health inequality, operates within social settings to provide evidence for developing practical public health strategies for T2DM management.

Table 4.5 General and social network characteristics of individuals with T2DM in Kumasi, Ghana; full sample and by low/moderate stigma

	Full sample (n=254)	**Low diabetes-related stigma: ≤1.31 (n=128)**	**Moderate diabetes-related stigma: >1.31 (n=126)**
Variable			
Age in years: mean (SD)	62.90 (10.20)	64.88 (9.76)	60.89 (10.28)
Gender (% female)	59.45	59.38	59.52
Ethnicity (%)			
Akan	82.29	80.47	84.13
Ewe	2.36	3.13	1.59
Grussi	2.36	2.34	2.38
Hausa	1.57	3.13	0.00
Mole Dagbani	1.18	0.78	1.59
Other ethnicity	10.24	10.16	10.32
Married (%)	57.09	54.69	59.52
Education (%)			
0-6 years of education	35.04	33.59	36.51
Completed JSS (middle school)	38.19	33.59	42.86
Completed SSS (high school) or higher	26.77	32.81	20.63
Monthly income (%)			
Less than 200 Ghana cedis[a]	23.38	20.20	26.47
200-499 Ghana cedis	37.81	36.36	39.22
500 Ghana cedis or more	38.81	43.43	24.31
Work status (%)			
Employed full-time	32.28	27.34	37.30
Unemployed	26.38	23.44	29.37
Retired	21.26	28.13	14.29
Other	20.08	21.10	19.05
T2DM duration in years: mean (SD)	13.14 (7.10)	13.17 (6.91)	13.10 (7.31)
Number of T2DM comorbidities: mean (SD)	0.88 (0.61)	0.89 (0.52)	0.87 (0.69)
HbA1c %: mean (SD)	9.22 (2.60)	9.06 (2.53)	9.39 (2.68)
Social network characteristics: mean (SD)			
Network size	4.08 (1.31)	4.02 (1.32)	4.15 (1.31)
Kin composition	0.80 (0.25)	0.79 (0.26)	0.82 (0.24)
Household composition	0.56 (0.32)	0.54 (0.32)	0.59 (0.31)
Network density	0.94 (0.21)	0.95 (0.18)	0.92 (0.23)
Perceived diabetes social support: mean (SD)	3.53 (1.03)	3.61 (1.03)	3.46 (1.04)
Diabetes-related stigma: mean (SD)	1.40 (0.40)	1.16 (0.09)	1.65 (0.43)
Perceived stigma subscale: mean (SD)	1.35 (0.44)	1.14 (0.15)	1.55 (0.54)
Enacted stigma subscale: mean (SD)	1.46 (0.44)	1.20 (0.18)	1.72 (0.47)
Self-stigma subscale: mean (SD)	1.40 (0.64)	1.10 (0.20)	1.71 (0.77)

[a]At the time of the study, $1 was approximately equivalent to 4.4 Ghana cedis

Table 4.6 Results of linear regression models showing the effects of diabetes-related, self-stigma as a moderator of associations between social network characteristics and perceived diabetes social support

	Models without interaction term β (SE)			**Models with interaction term β (SE)**		
Dependent variable: Perceived diabetes social support (PDSS)	**Model 1 (n=247)**	**Model 2 (n=246)**	**Model 3 (n=247)**	**Model 1 (n=247)**	**Model 2 (n=246)**	**Model 3 (n=247)**
Social network characteristics						
Kin composition	0.69 (0.25)*	–	–	2.14 (0.56)***	–	–
Household composition	–	0.51 (0.20)*	–	–	0.74 (0.47)	–
Network density	–	–	0.55 (0.33)	–	–	0.26 (0.59)
Network size	0.23 (0.05)***	0.22 (0.05)***	0.18 (0.05)**	0.23 (0.05)***	0.23 (0.05)***	0.18 (0.05)**
Diabetes-related, self-stigma	-0.16 (0.10)	-0.20 (0.10)	-0.14 (0.10)	0.60 (0.28)*	-0.12 (0.17)	-0.29 (0.26)
Kin composition* Diabetes-related, self-stigma	–	–	–	-0.97 (0.34)**	–	–
Household composition* Diabetes-related, self-stigma	–	–	–	–	-0.16 (0.30)	–
Network density* Diabetes-related, self-stigma	–	–	–	–	–	0.18 (0.29)
Gender						
Female	Referent	Referent	Referent	Referent	Referent	Referent
Male	0.21 (0.14)	0.21 (0.14)	0.25 (0.14)	0.20 (0.14)	0.21 (0.14)	0.25 (0.14)
T2DM duration (years)	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.01)
Education						
0-6 years of education	Referent	Referent	Referent	Referent	Referent	Referent
Completed junior secondary school	0.29 (0.15)	0.25 (0.15)	0.24 (0.15)	0.31 (0.15)*	0.25 (0.15)	0.24 (0.15)
Completed senior secondary school or higher	0.09 (0.17)	0.01 (0.17)	0.05 (0.17)	0.11 (0.17)	0.01 (0.17)	0.05 (0.17)
Number of T2DM comorbidities	0.18 (0.10)	0.22 (0.10)	0.19 (0.11)	0.24 (0.10)*	0.22 (0.10)	0.21 (0.11)
R^2	0.15	0.15	0.13	0.18	0.15	0.14
Model p-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

*p<0.05; **p<0.01; ***p<0.001

Table 4.7 Results of linear regression models estimating the influence of kin composition on perceived diabetes social support, stratified by low/high diabetes-related, self-stigma

Dependent variable: Perceived diabetes social support (PDSS)	**Low diabetes-related, self-stigma: ≤1.17 (n=141)**	**Moderate diabetes-related, self-stigma: >1.17 (n=106)**
Kin composition	1.25 (0.31)***	0.10 (0.39)
Network size	0.15 (0.06)*	0.33 (0.07)***
Gender		
Female	Referent	Referent
Male	0.12 (0.18)	0.19 (0.22)
T2DM duration (years)	0.00 (0.01)	-0.04 (0.02)*
Education		
0-6 years of education	Referent	Referent
Completed junior secondary school	0.62 (0.20)	-0.02 (0.21)
Completed senior secondary school or higher	0.18 (0.21)	0.09 (0.28)
Number of T2DM comorbidities	0.31 (0.16)	0.04 (0.13)
R^2	0.21	0.22
Model p-value	<0.0001	0.001

*p<0.05; **p<0.01; ***p<0.001

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4.3 MANUSCRIPT 3

The effects of the frequency of religious participation and use of traditional medicine on HbA1c control in urban Ghana[5]

[5] Botchway M., Davis R.E., Moore, S., Appiah, L.T., Merchant A.T. To be submitted to *the Journal of Religion and Health.*

Abstract

This study examined whether the frequency of participation in religious activities and the frequency of seeking care from traditional medicine (TM) practitioners were associated with blood glucose (HbA1c) control among urban Ghanaians with type 2 diabetes mellitus (T2DM). Findings revealed that increased frequency of participation in religious activities was significantly associated with decreased HbA1c levels; however, increased use of TM practitioners was significantly associated with increased HbA1c levels. For Ghanaians who self-identify as religious, the integration of religious practices into T2DM management may be valuable for HbA1c control.

Keywords: religious participation, traditional medicine, type 2 diabetes, Ghana, medical pluralism

Introduction

The increasing prevalence of type 2 diabetes mellitus (T2DM) is a public health challenge worldwide, especially in low- and middle-income countries (LMICs) that have high rates of infectious diseases and weak healthcare systems (Cho et al., 2018; Dagenais et al., 2016; Mbanya, Motala, Sobngwi, Assah, & Enoru, 2010). For example, studies indicate that individuals with T2DM in Ghana struggle with daily disease management and often have a poor quality of life (Mogre, Mwinlenaa, Oladele, & Amalba, 2012; Osei-Yeboah et al., 2016). Due to a lack of social safety nets and an under-funded healthcare system, Ghanaians often have limited options for disease management and make healthcare choices that reflect their economic, cultural, and social contexts (Smith-Cavros, Avotri-Wuaku, Wuaku, & Bhullar, 2017). There is substantial evidence indicating that engagement with religion and traditional medicine (TM) affects health and well-being, especially among Ghanaians with chronic diseases (Atobrah, 2012; Hampshire & Owusu, 2013; Kpobi & Swartz, 2018; Pokimica, Addai, & Takyi, 2012). At least one study suggests that Ghanaians with diabetes rely either exclusively or concurrently upon biomedical, traditional, and religious-based strategies for disease management (de-Graft Aikins, 2005). While Ghanaians evidently engage in medical pluralism (the concurrent use of multiple strategies for disease treatment) (Smith-Cavros et al., 2017), few studies have examined how non-biomedical strategies affect clinical T2DM outcomes.

Outside Ghana, there is extensive evidence of the salutary effects of religion on health and well-being (Ellison & Levin, 1998; Koenig, 2012; Moreira-Almeida, 2013; Zimmer et al., 2016). Robust findings, mainly from high-income countries (HICs), show

that attendance at religious services and related activities is one of the most important predictors of physical and mental health (George, Ellison, & Larson, 2002; Li, Stampfer, Williams, & VanderWeele, 2016; Zimmer et al., 2019). Church/mosque attendance provides opportunities for social interaction (Krok, 2014) and has been associated with increased emotional support and higher satisfaction with health outcomes (Krause & Wulff, 2005), improved mental health (Chaaya, Sibai, Fayad, & El-Roueiheb, 2007; Krok, 2014), and a lower rate of suicide (VanderWeele, Li, Tsai, & Kawachi, 2016).

Several studies have explored the effects of religion on health outcomes among individuals with diabetes. For example, in a cross-sectional study of Black women with T2DM in the U.S., poorer HbA1c was associated with more reliance on God, which may have mitigated psychological distress (Newlin, Melkus, Tappen, Chyun, & Koenig, 2008). In some HICs, adults with T2DM and/or cardiovascular disease have reported that participating in religious services and spiritual healing groups, praying, and reading the Bible have helped them in developing a renewed sense of hope and building resilience for managing their health (Choi & Hastings, 2018; Namageyo-Funa, Muilenburg, & Wilson, 2015; Samuel-Hodge et al., 2000; Unantenne, Warren, Canaway, & Manderson, 2013). Measures of religiosity, including increased attendance at religious services, have also been associated with improved diabetes care (Heidari, Rezaei, Sajadi, Ajorpaz, & Koenig, 2017; Rivera-Hernandez, 2016). Together, these studies suggest that religious engagement may be a positive influence on T2DM management. However, as the manifestation of religion and religious practices is often shaped by geographic and indigenous factors (Kpobi & Swartz, 2018), religious sentiments and influences in Ghana may differ from those in other countries with the same religious affiliations. Thus,

research is needed to explore the influence of religion on T2DM outcomes in a Ghanaian context.

Ghana has been described as one of the most religious countries in sub-Saharan Africa (Takyi & Lamptey, 2016), with approximately 96% of Ghanaians reporting an affiliation with an organized or traditional religion (CIA, 2017; Takyi & Lamptey, 2016; WIN-Gallup International, 2012). Research demonstrates that Ghanaians often rely on personal prayer and church attendance to cope with T2DM (de-Graft Aikins, 2003, 2005). For the present study, religion was operationalized as an organized system consisting of publicly or privately conducted practices, beliefs, and ceremonies to enable a relationship with God or higher spiritual power and/or facilitate one's interactions with other individuals and communities (Koenig, 2012; Newlin et al., 2008). An estimated 71% of the Ghanaian population identifies as Christian, 17.6% as Muslim, and 5.2% as traditional religion believers (CIA, 2017; WIN-Gallup International, 2012). Throughout Africa, churches have been identified as potential sources of community resources (Campbell, Skovdal, & Gibbs, 2011), and, in Ghana, some Christian organizations provide social and economic assistance to members during challenging times (Pokimica et al., 2012). In addition to religious affiliation, Ghanaians have expressed high levels of religiosity in terms of the frequency with which they participate in religious services or other activities (Addai & Adjei, 2014; Gyimah, Adjei, & Takyi, 2012; Takyi & Lamptey, 2016). Religious participation in Ghana has been associated with better self-rated health (Addai & Adjei, 2014; Addai, Opoku-Agyeman, & Amanfu, 2014), and, as such, participation in religious activities may be an important influence on T2DM management.

However, few studies have examined associations between religious participation and health among Ghanaians with T2DM.

TM refers to indigenous approaches evolving from beliefs and experiences, which include the use of herbal remedies and the consultation of spiritual elements for maintaining health and treating various diseases (Mokgobi, 2014; World Health Organization, 2013). TM in Ghana is often spiritual in nature, and many TM practitioners consult deities to discover cures, and diagnose or treat disease (Amoah et al., 2014; Hampshire & Owusu, 2013; White, 2015). Currently, there is a World Health Organization strategy to assist countries in identifying ways through which TM can be effectively and safely integrated into existing health systems, but research and stringent policy implementation efforts are still lacking in many countries, including Ghana (Kretchy, Owusu-Daaku, & Danquah, 2014; Nyaaba, Masana, Aikins, Stronks, & Agyemang, 2018; World Health Organization, 2013). In Ghana, TM is often used for improving health because it is easily accessible, perceived as natural or organic, relatively inexpensive, and often more aligned with local values and beliefs about disease manifestation and health in comparison to biomedical strategies (R. M. Gyasi et al., 2016; R. Gyasi, Mensah, Adjei, & Agyemang, 2011; Kpobi & Swartz, 2018). It is estimated that more than 60% of Ghanaians use some form of TM (R. M. Gyasi, 2013; Hampshire & Owusu, 2013; S. Antwi-Baffour, 2014), which strongly suggests that the prevalence of TM use in Ghana is high. The TM practitioner-to-population ratio in Ghana is 1:200, while the physician-to-population ratio is 1:25, 000 (Kasilo, Trapsida, Mwikisa, & Lusamba-Dikassa, 2010). Consequently, it is substantially easier for most Ghanaians to seek care from a TM practitioner than a physician. TM practitioners include fetish priests,

herbalists, and spiritualists and tend to be more prominent in rural areas of the country (Mill, 2001; S. Antwi-Baffour, 2014). Previous studies suggest that TM products and services are advertised on TV, radio, in public buses, and marketplaces in Ghana (Nyaaba et al., 2018). TM is ubiquitous and inevitably a feature of the Ghanaian society, and the presence and use of TM practitioners appears to be appealing (Ae-Ngibise et al., 2010; Tabi, Powell, & Hodnicki, 2006).

A few studies among Ghanaians have described the use of TM in diabetes management. Some individuals with diabetes consulted TM practitioners because of what appeared to be the sudden onset of their symptoms, which they perceived as being caused by witchcraft (de-Graft Aikins, 2005). Others chose TM because it was cheaper than biomedical therapy, there was pressure from friends and family to use more natural healing approaches, and there were also beliefs that spiritual healers could cure diabetes without the use of medication (Atinga, Yarney, & Gavu, 2018). Some family members of people with diabetes encouraged the use of TM in place of biomedical strategies because they perceived that TM approaches would be faster in enabling healing from amputation and preventing any potential disease complications (de-Graft Aikins, 2005). However, some individuals adopted biomedical strategies for diabetes management because their past experiences led them to regard TM as ineffective (de-Graft Aikins, 2005). Although biomedical beliefs about disease etiology may be linked to lower use of TM, the presence of supernatural beliefs about the cause of disease does not automatically lead to the use of TM for diabetes treatment (Aikins et al., 2019). For example, Ghanaians with diabetes who have spiritual beliefs about the cause of disease may be more likely to adopt TM

because of financial constraints that limit access to routine clinical care (Aikins et al., 2019).

There is conflicting evidence from studies in other countries about the impact of TM on health outcomes. Some studies suggest that TM increases the risk of diabetes complications and worsens glycemic control (Matheka & Demaio, 2013; Mbeh et al., 2010). In contrast, a Turkish study observed that individuals with diabetes who reported using a variety of herbal treatments had significantly lower blood glucose (HbA1c) levels than those who did not use herbal treatments (Ilhan et al., 2016). Yet again, a Nigerian study found no significant differences in HbA1c between users and non-users of herbal and other plant-based mixtures for diabetes management (Ogbera, Dada, Adeleye, & Jewo, 2010). These studies suggest that the use of herbal treatments is the dominant type of TM for diabetes management in many African countries (Rutebemberwa et al., 2013). Few studies have systematically evaluated the use of plants for diabetes management in Ghana (Adinortey et al., 2019), and associations between the use of various forms of TM and HbA1c control have hardly been examined within an African context where TM is ubiquitous and many individuals with diabetes engage in medical pluralism.

The goal of the present study was to evaluate how frequency of participation in religious activities and the frequency of seeking care from TM practitioners influenced HbA1c control among adults with T2DM (Figure 4.2). Specifically, we hypothesized that participation in religious activities would be inversely associated with HbA1c. We also predicted that social support would mediate this relationship, such that individuals with more frequent religious participation would have more support, which would be associated with decreased HbA1c. Most research from HICs indicates that social support

may be an important explanatory mechanism linking religion and health (Darvyri et al., 2018; Koenig, 2012). However, similar research within LMIC settings is scarce. We similarly hypothesized that increased frequency of seeking care from TM practitioners would be associated with increased HbA1c. Social support was not tested as a mediator of this association as evidence that TM operates through this mechanism was lacking.

Methods

Participants

Between July and August 2018, data were obtained from a cross-sectional survey, which was administered to 254 T2DM patients at the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana. KATH is the second-largest hospital in the country (Kretchy et al., 2014). Eligible study participants were: (1) at least 18 years old; (2) diagnosed with T2DM for at least one year; and (3) fluent in speaking English or Twi, which were the dominant languages within the patient population. Trained research staff generated a daily list of eligible participants by screening the medical records of patients who were present for routinely scheduled clinical visits. The study was approved by the Institutional Review Board at the University of South Carolina and the Committee on Human Research, Publication and Ethics for the Kwame Nkrumah University of Science and Technology and KATH.

Data Collection

Using the generated patient lists, research staff recruited potential study participants by approaching them in the waiting area at KATH's diabetes clinic. After they identified those who were interested in the study and completed verbal and written

informed consent processes with them, a nurse at the clinic measured participants' HbA1c levels. A research staff member then took the participant to a private area in the clinic, where they orally administered an approximately 40-minute, paper-based questionnaire that was available in English or Twi, according to each participant's language preferences. Each participant who completed the survey received a post-incentive of 15 Ghana cedis (approximately $3.4).

Measures

HbA1c

An SD BIOSENSOR, standard A1cCare Analyzer and test kits (SD A1cCare Analyser, n.d.) were used to assess patients' HbA1c levels, and the raw values were treated as continuous data for analytical purposes. HbA1c assessments were successfully completed for 234 participants. There were error readings for the remaining 20 participants.

Frequency of participation in religious activities

This variable was measured using responses to four items. Two items were obtained from the religious public practices subscale from the (Fetzer Institute/ National Institute on Aging Working Group, 2003), which measures the frequency of attendance at religious services and other activities in a place of worship. Two additional items were created by the study team: "How often do you take part in Bible study groups, religious prayer meetings, or other religious activities somewhere other than a place of worship?" and "How often do you take part in volunteer activities that are organized by your religious group?" The intent of these items was to capture other common activities, like

communal praying, that some religious groups organize in Ghana but which do not always occur at a formal place of worship (Reinhardt, 2017). The religious public practices subscale typically uses a 9-point Likert scale with response options ranging from "never" (=1) to "several times a week" (=9) (Fetzer Institute/ National Institute on Aging Working Group, 2003). However, in order to minimize questionnaire burden for both the participants and interviewers (Dillman, Smyth, & Christian, 2014), two response options ("about once a year" [=2] and "nearly every week" [=7]) were dropped from the response scale for the present study, and an additional response option for "every day" (=8) was included to accommodate study participants who may be engaged in daily religious activity. The revised 8-point Likert scale ranged from "never" (=1) to "every day" (=8). All four items were combined to compute an average score for religious participation, with higher scores indicating more frequent religious participation (α=0.75).

Frequency of seeking care from Traditional Medicine (TM) practitioners

Three items were developed to measure the frequency with which participants consulted TM practitioners for T2DM management. The first item measured participants' use of herbalists, the second item measured participants' use of spiritualists, and the third item measured the use of fetish priests. All items were accompanied by a 5-point Likert scale with response options ranging from "never" (=1) to "always" (=5). Responses to these items were combined to compute an average score indicating the frequency of use of these alternate sources of T2DM management, with higher scores reflecting more frequent use of these sources (α=0.62).

Perceived diabetes social support (PDSS)

PDSS was created using responses to 13 items. Twelve items were adapted from the emotional/informational support subscale and the tangible (instrumental) support subscale from the Medical Outcomes Study Social Support Survey (MOS-SSS) (Al-Dwaikat & Hall, 2017; Sherbourne & Stewart, 1991). The MOS-SSS was initially developed to evaluate access to different types of support among patients with chronic conditions, including diabetes (Sherbourne & Stewart, 1991). To capture assistance from informal social networks in the current study, the 12 MOS-SSS scale items were modified to reflect access to diabetes-related support outside of a clinical setting. For example, an original emotional support item, "How often is each of the following kinds of support available to you if you need it: Someone you can count on to listen to you when you need to talk?" was modified to "Outside of a clinic environment, how often do you have access to someone who you can count on to listen to you when you need to talk about your diabetes?" An additional item on financial support was created by the study team: "How often do you have access to someone who can help you pay for your diabetes medical expenses?" This item was added because previous research in Ghana has suggested that financial support for health purposes is often lacking from social networks (Aboderin, 2004; de-Graft Aikins, 2006; MacLean, 2011). All items used a 5-point Likert scale with response options ranging from "none of the time" (=1) to "all of the time" (=5). All 13 items were combined to compute an average score for diabetes-specific support, with higher scores indicating higher levels of support (α=0.87).

Covariates

We measured and examined the following participant characteristics as covariates: age in years; gender (male or female); education (0-6 years of education, completed junior secondary school [JSS], completed senior secondary school [SSS] or higher); number of self-reported, T2DM comorbidities; and duration of T2DM (time since diagnosis in years).

Analysis

All analyses were conducted using SAS® software (SAS Institute Inc., 2013). First, we ran descriptive and bivariate statistics to identify sample characteristics and inform variable creation and statistical modelling decisions. Education and income had a moderately significant correlation ($r=0.40$, $p<0.0001$), so we excluded income from further multivariable analyses as the education variable had less missing data than the income variable. Secondly, we ran an ANOVA test to determine whether the frequency of participation in religious activities differed across study participants with varying Christian denominations. Results indicated that there were no significant differences in the average frequency of participation in religious activities across denominations ($F=1.24$, $p=0.27$), and that equal variances across the denominations could be assumed ($p=0.67$). Thirdly, multivariable linear regression models were run to estimate associations between the frequency of participation in religious activities and HbA1c, social support and HbA1c, and the frequency of participation in religious activities and social support. Fourthly, associations between the frequency of seeking care from TM practitioners and HbA1c were examined using a multivariable linear regression model.

All regression models were adjusted for age, gender, duration of T2DM, education, and number of T2DM comorbidities.

Results

The demographic and health characteristics of the 254 study participants are shown in Table 4.8. Nearly 75% of individuals with T2DM (n=176) had an HbA1c reading greater than 7.0 %, indicating poor glycemic control. Most participants (n=230) self-identified as Christian with the following breakdown of denominations: Anglican (n=5, 2.08%); Baptist (n=10, 4.17%); Catholic (n= 45, 18.75%); Jehovah's Witness (n=10, 4.17%); Methodist (n=46, 19.17%); Pentecostal (n= 45, 18.75%); Presbyterian (n= 18, 7.50%); other denominations (n= 41, 17.08%); no specific denomination (n=1, 0.42%). The average frequency of religious participation was 4.40. Few participants consulted TM practitioners (Table 4.9), with only 18.9% (n=48) reporting that they used at least one TM practitioner. Nine participants indicated that they used more than one type of TM practitioner. Herbalists were the most common type of TM practitioners that study participants engaged for T2DM treatment, and the frequency of use of TM practitioners was low with an average value of 1.16 (Table 4.8).

Model 1 examined the relationship between the frequency of participation in religious activities and HbA1c (Table 4.10). There was a significant negative association between frequency of participation in religious activities and HbA1c (p=0.03), such that as religious participation increased, HbA1c decreased. Additionally, as age increased, HbA1c significantly decreased (p=0.002). Model 2 examined the relationship between social support and HbA1c. As social support increased, HbA1c also increased (p=0.06). Like model 1, this model indicated an inverse association between age and HbA1c

(p=0.003). There was no significant association between frequency of participation in religious activities and social support, so those regression results are not shown.

Model 3 showed the association between the frequency of seeking care from TM practitioners and HbA1c (Table 4.10). Findings indicated that there was a significant positive association between the frequency of seeking care from TM practitioners and HbA1c (p=0.004), indicating that as the frequency of TM use increased, HbA1c increased. Specifically, for every one-unit increase in the use of TM for diabetes management, the average HbA1c value increased by 1.40. For this model, age was also a significant predictor of HbA1c (p=0.004).

Discussion

In this study, we examined whether HbA1c control was associated with either the frequency of participation in religious activities or the frequency of seeking care from TM practitioners among a clinical sample of urban Ghanaians with T2DM. As predicted, there was a significant association between increased frequency of participation in religious activities and reduced HbA1c levels. This is consistent with prior research, mainly in HICs, that has identified the salutary benefits of religion on health outcomes among individuals with diabetes (Heidari et al., 2017; Kilbourne, Cummings, & Levine, 2009; Newlin et al., 2008; Rivera-Hernandez, 2016). Our observation also resonates with the identification of religious attendance as an important predictor of health and well-being (George et al., 2002). Although our study did not measure whether participation in religious activities was an intentional coping strategy for T2DM, it is likely that this may have been the case, as suggested by previous studies in Ghana (de-Graft Aikins, 2003,

2005). Involvement in religious activities may reduce stress proliferation and mitigate the effects of any related stress-inducing mechanisms on health (Morton, Lee, & Martin, 2017). Frequent participation in religious activities may also yield a renewed sense of hope among study participants to cope with their illness and increase their resilience to strive for better T2DM management (Unantenne et al., 2013). Considering the high value that Ghanaians appear to place on religiosity (Pokimica et al., 2012), our observations strongly suggest that incorporating religious practices into T2DM management within this population may be valuable. For example, in clinical settings, health professionals can determine if their T2DM patients are religious, and when appropriate, engage in discussions about the strategic integration of religious activities into T2DM management plans for those who self-identify as religious. Additionally, and as Rivera-Hernandez (2016) suggests, strategic partnerships between religious institutions and healthcare professionals may enable platforms for health promotion and improve coping skills for disease management among Ghanaians.

We did not find support for some of our hypotheses as there were no significant associations between frequent participation in religious activities and social support or between support and HbA1c. Contrary to some of the existing literature from HICs (Darvyri et al., 2018; Koenig, 2012), social support did not mediate the links between religious participation and HbA1c among our study participants. It is possible that a more specific measure of church/mosque-related social support may have been a better predictor of HbA1c, as demonstrated in previous studies assessing self-rated health (Assari, 2013; Krause, 2002). Such forms of support should be considered in future studies that examine the influence of Ghana's religious landscape on health outcomes.

Furthermore, additional research that evaluates other explanatory mechanisms for associations between religion and health, such as the adoption or maintenance of positive health behaviors (Koenig, 2012; Zimmer et al., 2016), may provide a better understanding of how religion affects diabetes care and outcomes within a Ghanaian context. This was a cross-sectional study, but future research examining religious participation over the life course may be useful in identifying patterns in trajectories or transitions during which religious activity may be most relevant for managing T2DM. The multidimensional nature of religion also indicates that other constructs can be examined in additional studies on HbA1c control in Ghana. For example, religious beliefs may be an important predictor of some diabetes self-care activities among African Americans (Watkins, Quinn, Ruggiero, Quinn, & Choi, 2013), but its effects on HbA1c within a Ghanaian context are unknown.

Consistent with previous research in Ghana (Amegbor, 2017), our results revealed that the frequency of seeking care from TM practitioners was low among study participants. Additionally, our hypothesis about TM and HbA1c was supported such that more frequent use of TM practitioners was associated with increased HbA1c in the present study. This finding is consistent with at least one previous study in Ghana in which some individuals with diabetes perceived that TM use resulted in negative health effects (de-Graft Aikins, 2005). Previous research has indicated that chemical interactions between TM substances and clinically prescribed medications, or, in certain instances, the substitution of some medications with TM, may increase the likelihood of developing T2DM complications (Matheka & Demaio, 2013; Mbeh et al., 2010). Among our participants, such interactions may have occurred among those who also sought care from

TM practitioners, which may have led to increased HbA1c. However, testing and identifying the presence of adverse chemical interactions and their effects on HbA1c was beyond the scope of this study. While it is plausible that individuals with T2DM may have experienced negative health effects because of the frequent use of TM in addition to biomedical strategies, it is also likely that some people sought care from TM practitioners after unsuccessful attempts to control HbA1c with biomedical interventions. At least one study has observed that Ghanaians with T2DM and/or hypertension stop taking prescribed medications when they feel that their health is not improving (Atinga et al., 2018). Individuals with T2DM who perceive that their poor health outcomes are because of ineffective biomedical strategies may be more willing to use TM as an alternative coping method. Additionally, for some Ghanaians who perceive that disease, health, and spirituality are intrinsically linked to each other, the concurrent use of biomedical, religious and TM practices may be important for enabling both physical and psychological health (Smith-Cavros et al., 2017). Thus, in the present study, the use of TM practices for T2DM may have reflected the desire to address spiritual dimensions of health, especially when traditional beliefs about the cause or nature of disease exist. It is important to note that current study results contradict those from research in Turkey, in which users of herbal treatments experienced better HbA1c than non-users of herbal treatments (Ilhan et al., 2016). Variations in the nature, administration, and interactions of herbal treatments in Turkey and Ghana may explain observed findings. Further research can increase knowledge about how herbal treatments affect HbA1c control, especially in African populations.

Our findings about the links between religious participation, the use of TM practitioners, and HbA1c, have clinical and policy implications for a Ghanaian context. Good communication and interactions between health professionals and individuals with T2DM may be important for identifying self-reported health practices, providing concrete information on medical pluralism, and encouraging the adoption or maintenance of viable disease management strategies. Additionally, as others have indicated (Kasilo et al., 2010; Nyaaba et al., 2018; White, 2015), improved regulation of TM practitioners and products may be valuable in identifying the safety and efficacy of common TM products, monitoring the display and sale of TM products and services, and mitigating negative health outcomes among Ghanaians with chronic diseases like T2DM. Despite these important implications, this study has a few additional limitations. First, our convenience sampling approach may have limited the generalizability of our findings. Secondly, we only included study participants who were engaged in biomedically oriented care, but the effects of TM use and participation in religious activities may be more pronounced among individuals who exclusively engage in those practices and do not use biomedical strategies for other reasons. For example, some individuals with T2DM may have avoided the healthcare system for fear of being judged by health professionals and others who may not understand their TM choices or share their beliefs about TM. Thirdly, our sample mainly consisted of urban residents whose healthcare practices, needs, and values may have been different from those living in rural areas of Ghana. Finally, the variable measuring the frequent use of TM practitioners had a low Cronbach's alpha. Conducting a factor analysis and including other dimensions of TM for this measure may be important avenues for future research.

Little is known about the effects of religion on T2DM control outside of an HIC context, and research on links between TM use and HbA1c is scarce. However, by examining the role of religious participation and TM among individuals with T2DM, this study highlights ongoing practices within a Ghanaian context that may promote or hamper HbA1c control. Health professionals must become aware of these practices and recognize the unique but important roles that religious institutions and TM both play in shaping the health and well-being of Ghanaians with conditions like T2DM. Research in other LMICs, which may have different traditional beliefs, religious and healthcare contexts, is equally important in understanding how these factors affect HbA1c. Ultimately, sustainable and well-orchestrated collaborations among stakeholders will be invaluable in enabling a context within which informed decisions about T2DM management can be made without compromising personal beliefs and values that people hold.

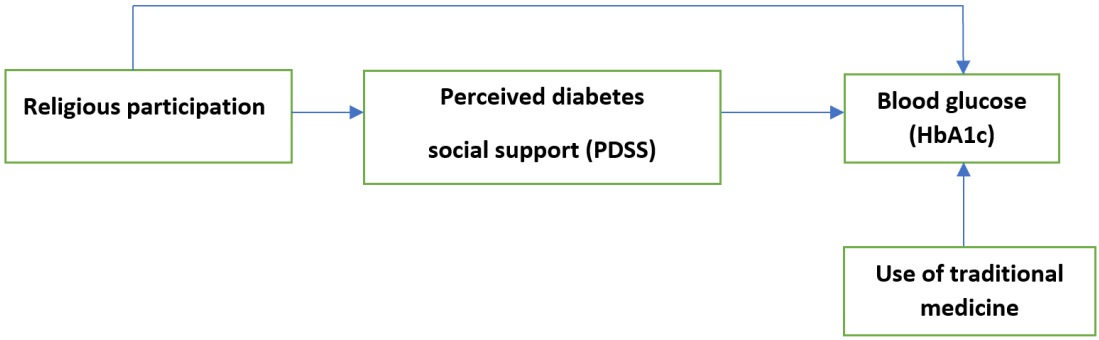

Figure 4.2 Conceptual model of relationships among participation in religious activities, the use of traditional medicine, and blood glucose control

Table 4.8 Characteristics of 254 individuals with T2DM in Kumasi, Ghana

Age in years: mean (SD)	62.90 (10.20)
Gender (% female)	59.45
Ethnicity (% Akan)	82.28
Religious affiliation (%)	
Christian	90.55
Muslim	8.66
Traditional religion	0.39
Did not identify with any religion	0.39
Frequency of participation in religious activities: mean (SD)	4.40 (1.77)
Frequency of seeking care from TM practitioners: mean (SD)	1.16 (0.45)
Frequency of seeking care from herbalists: mean (SD)	1.30 (0.80)
Frequency of seeking care from fetish priests: mean (SD)	1.09 (0.51)
Frequency of seeking care from spiritualists: mean (SD)	1.10 (0.51)
Married (%)	57.09
Education (%)	
0-6 years of education	35.04
Completed junior secondary school	38.19
Completed senior secondary school or higher	26.77
Monthly income (%)	
Less than 200 Ghana cedis[a]	23.38
200-499 Ghana cedis	37.81
500 Ghana cedis or more	38.81
T2DM duration in years: mean (SD)	13.14 (7.10)
Number of T2DM comorbidities: mean (SD)	0.88 (0.61)
HbA1c %: mean (SD)	9.22 (2.60)
Perceived diabetes social support: mean (SD)	3.53 (1.03)

Table 4.9 Use of traditional medicine (TM) practitioners by individuals with T2DM, n=254

TM category	Uses TM practitioners n (%)	Does not use TM practitioners n (%)
Herbalists	40 (15.75)	214 (84.25)
Fetish priests	9 (3.54)	245 (96.46)
Spiritualists	12 (4.72)	242 (95.28)

Table 4.10 Results of linear regression models estimating the effects of religious participation, perceived diabetes social support and the use of traditional medicine (TM) practitioners on HbA1c, n=229

Dependent variable: HbA1c	**Model 1**	**Model 2**	**Model 3**
Frequency of participation in religious activities	-0.22 (0.10)*	–	–
Perceived diabetes social support (PDSS)	–	0.25 (0.17)	–
Frequency of seeking care from TM practitioners	–	–	1.40 (0.48)**
Age (years)	-0.06 (0.02)**	-0.05 (0.02)**	-0.05 (0.02)**
Gender			
Female	Referent	Referent	Referent
Male	-0.42 (0.38)	-0.39 (0.39)	-0.30 (0.38)
T2DM duration (years)	0.04 (0.02)	0.04 (0.02)	0.04 (0.02)
Education			
0-6 years of education	Referent	Referent	Referent
Completed junior secondary school (middle school)	0.16 (0.42)	-0.11 (0.42)	-0.21 (0.41)
Completed senior secondary school (high school) or higher	0.66 (0.48)	0.47 (0.48)	0.33 (0.47)
Number of T2DM comorbidities	0.14 (0.29)	0.05 (0.29)	0.15 (0.28)
R^2	0.06	0.05	0.08
Model p-value	0.04	0.09	0.01

*p<0.05; **p<0.01; ***p<0.001

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CHAPTER 5

CONCLUSION AND IMPLICATIONS

This dissertation research adopted a social network approach in evaluating the influence of social relationships, gender, stigma, religion, and TM on HbA1c among urban Ghanaians. This final chapter summarizes the findings from the three study aims and concludes with limitations of the research and implications for public health practice and research, particularly in an LMIC context.

5.1 Summary of findings

Specific Aim 1 examined relationships between social network characteristics (kin composition, household composition and network density) and HbA1c among adults with T2DM in Kumasi, Ghana. The hypotheses were:

H1a. Social network characteristics (higher kin composition, higher household composition and higher network density) will be associated with decreased HbA1c.

H1b. The relationships between social network characteristics (kin composition, household composition and network density) and HbA1c will be mediated by perceived diabetes social support, such that those with higher social support will have decreased HbA1c.

Contrary to our hypotheses, neither social network characteristics nor social support were significantly associated with HbA1c. Higher kin composition and higher household composition were associated with increased social support; however, social

support did not mediate the relationships between any of the social network characteristics and HbA1c. Previous studies have yielded mixed findings about the links between social support and HbA1c, with some studies suggesting that increased social support is directly associated with decreased HbA1c and others finding no significant relationship between these two factors (Chew, Khoo, & Chia, 2015; Okura, Heisler, & Langa, 2009; Stopford, Winkley, & Ismail, 2013). Among our study participants, it is possible that social support may have had an indirect relationship on HbA1c and operated through other mechanisms. For example, a few studies have observed that self-efficacy and self-care behaviors, such as exercise, mediate the relationship between social support and HbA1c (Fortmann, Gallo, & Philis-Tsimikas, 2011; Gao et al., 2013). Since these variables were not measured in the present study, some of these mechanisms could not be evaluated among current study participants.

Furthermore, social network characteristics may have operated through other important psychosocial mechanisms, other than social support, to affect HbA1c in the study sample. For instance, social engagement, which is defined as interactions with others through participation in activities (Berkman, Glass, Brissette, & Seeman, 2000), may have been a more influential mechanism through which social network characteristics affected HbA1c in our sample. In Ghana's Ashanti Region, where the present study was conducted, previous research identified social engagement as an important predictor of well-being among older adults (Gyasi, Phillips, & Abass, 2018). Thus, social engagement may be an important mediator between social network characteristics and HbA1c among Ghanaian adults with T2DM in the Ashanti Region. Our findings, which indicated that increased kin composition and increased household

composition were associated with increased social support, were consistent with observations from studies in HICs (Chung, Jeon, & Song, 2016; Joensen et al., 2017), which suggest that kin-based networks and differences in household composition respectively are associated with increased support. Additionally, our findings highlighted how interactions with family and household members may be vital factors for support and resource mobilization for T2DM management outside of a clinical environment.

The results from Specific Aim 1 suggest several directions for future research. First, indirect associations between social support and HbA1c may be worth exploring to identify underlying mechanisms. Longitudinal studies of these associations may reveal important trends and provide a comprehensive understanding of network mechanisms, especially as social relationships and disease progression evolve over time. Secondly, studies should consider social engagement as a psychosocial mechanism that may potentially influence T2DM outcomes in Ghana as well as other LMICs. Thirdly, research that generates comparative data from other locations in Ghana, as well from different LMICs and HICs, will clarify how social networks function and their potential effects on HbA1c or other T2DM outcomes. Fourthly, social support from health professionals or peer groups, in addition to informal support, may be better predictors of improved HbA1c as previous research has identified their potentially vital contributions to enabling T2DM management (Heisler, 2007; Rosland et al., 2008). Finally, further research may identify other dimensions of structural and functional aspects of social relationships that matter for diabetes outcomes in countries like Ghana. For instance, the frequency with which Dutch adults with T2DM contact network members and their proximity to network members have previously been examined within the context of

T2DM complications (Brinkhues et al., 2018) and may be important factors for disease management in a Ghanaian setting.

Specific Aim 2 evaluated whether gender and stigma modified the relationships between social network characteristics (kin composition, household composition and network density) and HbA1c among our study participants. The hypotheses were:

H2a. The relationships between social network characteristics (kin composition, household composition and network density) and perceived diabetes social support will be moderated by diabetes-specific stigma, such that that those with higher stigma levels will have less social support and increased HbA1c.

H2b. The direct effect of social network characteristics (kin composition, household composition and network density) on HbA1c will differ between men and women.

H2c. The indirect effect of social network characteristics (kin composition, household composition and network density) on HbA1c, via perceived diabetes social support, will differ between men and women.

This aim, which examined three forms of diabetes-related stigma (self-stigma, perceived and enacted stigma), indicated that there was no significant difference in HbA1c among study participants reporting low or moderate diabetes-related stigma. Self-stigma moderated the association between kin composition and social support. However, self-stigma had no effect on the links between household composition and social support or between network density and social support. For study participants who reported low self-stigma, kin composition was positively associated with social support, but for those who reported moderate self-stigma, there was no association between kin composition

and support. Additionally, network size was positively associated with social support regardless of the level of self-stigma. None of the types of diabetes-related stigma moderated other associations among social networks, social support, and HbA1c. Also, there were no significant gender differences when examining the associations between social network characteristics, social support, and HbA1c.

In this study, the observed role of self-stigma as a moderator of the association between kin composition and social support highlighted the complex role that stigma may have played among individuals with T2DM. Higher levels of self-stigma may reduce self-efficacy and self-esteem among affected individuals who may consequently become withdrawn, depressed, and less likely to interact with existing but potentially supportive ties (Davison, Pennebaker, & Dickerson, 2000; Li, Mo, Wu, & Lau, 2017; Ritsher & Phelan, 2004). It is likely that Ghanaians with T2DM who reported moderate self-stigma may have become less socially engaged or felt less deserving of assistance from others, which may have created perceptions that social support had diminished. Another important result was that larger social networks were associated with increased social support, which aligned with previous findings of positive associations between network size and perceived social support in HICs (Seeman & Berkman, 1988). For participants in the present study, this positive association suggests that in comparison to compositional network characteristics, structural characteristics of networks, such as size, may be more important for social support. Larger networks that include varied social ties can provide opportunities to interact with non-family members or distal social connections who may be additional sources of social support. Larger networks can also facilitate access to diverse resources (Seeman & Berkman, 1988). Thus, people with T2DM who are

connected to many network members may potentially obtain assistance with different health-related needs from a larger range of sources.

To the best of our knowledge, this is the first study that has examined links between diabetes-related stigma, social networks, and HbA1c within an LMIC or Ghanaian setting. The findings provide important insights about diabetes-related stigma among Ghanaians with T2DM and suggest several avenues for further research. First, the moderating effect of self-stigma on access to social support strongly suggests that those who reported moderate diabetes-related, self-stigma may have lacked adequate social support for disease management. Therefore, identifying those who are at risk for moderate or high self-stigma at the clinical level may reveal instances where support or resource mobilization is likely to be more limited. Secondly, although this study was novel in examining different types of stigma among Ghanaians with T2DM, the causal linkages between diabetes-related stigma and social networks are still not well understood. Longitudinal studies in both LMICs and HICs are needed to examine how both stigma and social interactions affect HbA1c, while increasing our understanding of contextual factors that affect these disease mechanisms over time. Thirdly, social support among our study participants may have operated through a buffering process, which considers the effects of stress on health outcomes and how support may mitigate those effects (Cohen & Wills, 1985). Further research can examine if social support minimizes the effects of stress on HbA1c, particularly among those with high diabetes-related self-stigma. Fourthly, the positive association between network size and social support suggests that future network interventions that link people with T2DM to institutional resources, such as diabetes peer support groups, in Ghana and other similar contexts may

provide them with additional health education and emotional support. Finally, further research is necessary to more fully examine the psychometric properties of the diabetes-stigma scale that was used in this study, as well as its appropriateness for use in other settings.

Specific Aim 3 examined the effects of religious participation and TM on perceived diabetes social support and HbA1c among adults with T2DM in Kumasi, Ghana. The hypotheses were:

H3a. Increased religious participation will be associated with decreased HbA1c.

H3b. The relationship between religious participation and HbA1c will be mediated by social support such that those with higher social support will have decreased HbA1c.

H3c. Increased use of TM will be associated with increased HbA1c.

Study findings highlighted the high frequency of religious participation within the study sample, which, as predicted, was significantly associated with decreased HbA1c levels. Contrary to our hypothesis, social support did not mediate the relationship between religious participation and HbA1c in this study. The findings on the links between religion and HbA1c are consistent with previous research, mainly in HICs, that has identified the salutary benefits of religion on health outcomes among individuals with diabetes (Heidari, Rezaei, Sajadi, Ajorpaz, & Koenig, 2017; Kilbourne, Cummings, & Levine, 2009; Newlin, Melkus, Tappen, Chyun, & Koenig, 2008; Rivera-Hernandez, 2016). Involvement in religious activities may mitigate stress proliferation and the effects of stress-inducing mechanisms on health (Morton, Lee, & Martin, 2017). Furthermore, frequent participation in religious activities may enable a renewed sense of hope among

study participants to cope with their illness and increase their resilience to strive for better T2DM management (Unantenne, Warren, Canaway, & Manderson, 2013). The high value that Ghanaians appear to place on religiosity (Pokimica, Addai, & Takyi, 2012), as well as our current findings, strongly point to the potential benefits of incorporating religious practices into T2DM management. For instance, health professionals can determine whether individuals with T2DM are religious and, when appropriate, engage in discussions about the integration of religious activities into T2DM management plans for those who self-identify as religious.

Consistent with previous research in Ghana (Smith-Cavros, Avotri-Wuaku, Wuaku, & Bhullar, 2017), results from this study indicated that participants with T2DM engaged in medical pluralism. Additionally, few study participants sought care from TM practitioners, which is not surprising since participants were drawn from a clinic population. However, frequent use of TM practitioners was significantly associated with increased HbA1c. A handful of studies has indicated that chemical interactions between TM substances and clinically prescribed medications, or, in certain instances, the substitution of medications with TM, may increase the likelihood of developing T2DM complications (Matheka & Demaio, 2013; Mbeh et al., 2010). Among our participants, it is plausible that such interactions may have occurred among those who also sought care from TM practitioners, which may have led to increased HbA1c. However, testing and identifying the presence of adverse chemical interactions and their effects on HbA1c was beyond the scope of this study. This is an important avenue for further research, particularly within an LMIC context where many people may heavily rely on TM practices because of their spiritual associations and/or the availability of TM providers as

a low-cost alternative in the context of under-funded healthcare systems (Smith-Cavros et al., 2017). Additionally, good communication and interactions among health professionals and individuals with T2DM may enable critical conversations about medical pluralism. Encouraging dialogue around self-reported health practices may provide affected individuals with concrete information so they are aware of how medical pluralism can potentially undermine viable disease management strategies. As others have indicated (White, 2015), improved regulation of TM practitioners and products can mitigate negative health outcomes among Ghanaians with chronic diseases like T2DM. Furthermore, some individuals with T2DM may have avoided the healthcare system for fear of being judged by health professionals and others who may not understand their choices to use TM or share their beliefs about TM. Health education efforts may be vital in conveying to these individuals who typically use TM and do not visit clinics that they will not be judged for their choices. Additionally, and as suggested (Hill et al., 2014), public health education strategies could promote more understanding of TM among physicians and other biomedical health professionals and also explore more innovative ways in which biomedical professionals and TM practitioners can work together.

5.2 Limitations of the study

Although this research has provided many important insights about whether social networks, gender, stigma, religious participation, and the use of TM practitioners affect HbA1c among Ghanaians with T2DM, it has several limitations. First, since a cross-sectional study design was applied, it was impossible to determine causality among any of the observed findings. Secondly, the convenience sampling approach, which was necessitated by the practical constraints of the clinic operation, may have limited the

generalizability of the findings. Thirdly, as study participants were mainly urban residents, their needs and values may have been different from those of others living elsewhere in Ghana or in other LMICs, especially those who live in rural areas. Fourthly, for specific aims 1 and 2, there was a limit to the number of alters that study participants could identify, so the artificial restriction of their social networks may not have fully captured the nature of their social relationships. Additionally, people with T2DM who are very sick or who could not afford to travel to the hospital may potentially differ from study participants in ways that shape how social relationships, social support and HbA1c are linked. Future studies that occur outside of a clinical setting can capture how those individuals may differ from a clinical sample, as well as individuals who do not engage with biomedical health care providers for other reasons. Furthermore, study participants reported low or moderate diabetes-related stigma, but these levels of stigma and their effects may differ among other groups of Ghanaians with T2DM. Finally, this study captured only certain aspects of TM and religiosity, but both are multidimensional in nature with several other constructs that can be examined in future research on HbA1c within an LMIC context.

5.3 Conclusion

This study provides an important contribution to the public health literature by examining the influence of social networks, gender, stigma, religiosity, and TM on HbA1c control in an LMIC context where the prevalence of diabetes is rapidly increasing. Study findings provide evidence for theoretical links from social networks to HbA1c among Ghanaians with T2DM. The study also highlights the low frequency of diabetes-related stigma in a clinical sample of Ghanaians with T2DM, but it strongly

indicates that there are negative effects of stigma on access to social support and disease management. Finally, the study has identified critical ways in which religious participation and the use of TM practitioners can shape HbA1c among Ghanaians who have previously been identified as very religious and heavily dependent on TM for healthcare needs (Gyasi et al., 2018; Pokimica et al., 2012). While these findings point to several directions for future research, they also shape the current understanding of the Ghanaian context in which diabetes-related healthcare decisions are made and provide suggestions for initial steps that can be taken to improve health outcomes within clinical settings. Further research in other parts of Ghana, as well as in other LMIC settings, can build upon the current study and ultimately provide more comprehensive evidence to inform the development of sustainable and practical health programs and policies that improve diabetes care and related health outcomes.

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APPENDIX A

COGNITIVE INTERVIEW GUIDE

INTERVIEWER/STUDY INFO:

PARTICIPANT NAME: _____

INTERVIEWER NAME: _____

INTERVIEW DATE: _____

1. What language are you most comfortable speaking, English or Twi?:
2. What Ghanaian languages do you speak?:
3. Participant gender: **Male** **Female**
4. Can you please tell me how old you are?
5. For how many years have you had type 2 diabetes?

Instructions for subjects

Please read the following instructions to the respondent:

Thanks again for meeting with me today. I am interviewing you because I need your help with improving survey questions about the experiences of type 2 diabetes patients. Have you ever participated in a survey?

Circle response given: YES NO DON'T KNOW/NOT SURE

A survey collects information about people through standard procedures. This means that every person who participates in the survey is asked the same question in the same way.

For example, many survey questions ask people to say how much they disagree or agree with a statement. **If you have ever taken a test in primary school, JSS or SSS, then survey questions are very similar to multiple choice questions where you have a question and response options ranging from "a" to "e" from which you must select one. Those tests in school usually had only one correct answer. However, the survey questions we will discuss today are different because there are no right or wrong answers – we just want to know about your personal experiences and perspectives.**

Unlike participating in a typical survey, the goal of the interviews we're doing now is to find out whether the survey questions are good ones. I want these questions to be clear and make sense from a person's real-life perspective. I also want the questions to be appropriate for Ghanaians who have type 2 diabetes. I want to make sure that the answer choices for the survey questions are okay and capture all possible responses to the questions. Throughout our interview, I'll ask you to answer survey questions, just like you were responding to multiple choice questions as a student. After you answer each question, I'll ask you additional questions to find out what you thought of the main question. In addition to answering the questions, your most important job is to tell me if any question or response option seems confusing, hard to answer, offensive, or inappropriate. Do you have any questions before we start?

Practice section for verbal probing

Let's begin with some practice questions.

Question: What did you have for dinner yesterday?

Probe: How did you come up with that answer?

Probe: At what time of the day did you eat that food?

Question: How did you come to the clinic today? Did you: walk or take “trotro”?

Probe: Let’s talk a bit about how you answered the question. Did you use more than one form of transportation?

Question: In the past six months, how many times have you been to a doctor?

Probe: How are you counting the number of times you have been to the doctor?

Probe: What type of person comes to mind when you hear the word, “doctor”?

That’s it for the practice questions. Do you have any questions before we continue to the real questions?

Cognitive interviewing on selected items/scales

Ok, now we will start.

1. The next set of questions focuses on people in your life and your relationships with them. You can provide a first name or a nickname instead of their real name if you prefer. Please name up to three people with whom you have discussed matters that are important to you within the past 6 months. [**WRITE THE NAME OF EACH PERSON ON A SEPARATE LINE**]

Person 1: _____

Person 2: _____

Person 3: _____

Probe 1a. What does the phrase "matters that are important" mean to you?

Probe 1b. When thinking about people with whom you have discussed important matters, how did you decide which people to list or name?

Probe 1c. How did the 6 month time-frame in the question affect the type of people whom you decided to list?

2. Can you please name up to three people, if any, who have helped you with daily tasks? Think about things like shopping, preparing your food, cleaning, washing your clothes, or other things that you need to do at home within the past 6 months.
[**WRITE THE GIVEN NAME OF EACH PERSON ON A SEPARATE LINE**]
Person 4: _____

Person 5: _____

Person 6: _____

Probe 2a. What comes to mind when you hear the phrase "things you need to do at home"?

Probe 2b. What specific tasks do these people do for you?

Probe 2c. What other tasks do you get help with at home, if any?

Probe 2d. What were some of the diabetes-related activities that came to mind when you heard the question?

3. Does [PERSON 4] have a relationship with [PERSON 5] as a friend, family member or some other type of connection?

Probe 3a. If you are to repeat the question I just asked, how would you say it?

Probe 3b. In the question I just read to you, how do you understand the term "relationship"?

Probe 3c. What came to mind when I said "other type of connection"?

For each multiple-choice answer, circle respondent's choice before moving to probes.

4. Please think about your daily life and activities when you are not at a clinic or hospital. During some of these daily activities at home, at work or elsewhere, we know that people sometimes look to their friends, family members or others they know for companionship, assistance, or other types of help.

4.1. How often do you have access to someone you can count on to listen to you when you need to talk about your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4a. What does the phrase "someone you can count on" mean to you?

Probe 4b. If you "have access to someone" what does that mean to you?

Probe 4c. How often do you want to talk about your diabetes with someone when you are not at the clinic? *Only ask this next question if the person says they don't need to talk about their T2D:* So if you don't need to talk about your diabetes, how did you decide to answer the question?

4.2. How often do you have access to someone who can share your most private worries and fears about diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4d. In your own words, what is this question asking? How did you understand the question?

Probe 4e. Which types of people came to mind when I said "someone who can share your most private worries and fears"?

Probe 4f. Did you think that the person must have diabetes too?

4.3. How often do you have access to someone who can give you good advice about a crisis related to your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4g. What came to mind when I said "a crisis related to your diabetes"?

Probe 4h. Which types of people came to mind (Who were you thinking about) when I said "someone who can give you advice"?

Probe 4i. So were you thinking of only people with medical knowledge or were you thinking of other types of people?

Probe 4j. When I said "someone is available a little of the time", what did that mean to you?

Probe 4k. When I said "someone is available some of the time", what did that mean to you?

Probe 4l. What is the difference between "a little of the time" and "most of the time"?

4.4. How often do you have access to someone who you can confide in or talk to about problems with your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4m. What does "confide in" mean to you?

Probe 4n. What does "talk to" mean to you?

Probe 4o. How are "confide in" and "talk to" different from each other?

4.5. How often do you have access to someone who can understand your problems with diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4p. Which kinds of people came to mind when I said "someone who can understand your problems with diabetes?

Probe 4q. Were you only thinking of someone else with diabetes or were you thinking of other types of people?

Probe 4r. How often do you have problems with diabetes?

Probe 4s. If you don't often have problems with diabetes, how did you decide to answer the question?

4.6. How often do you have access to someone whose advice you really want about your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4t. What types of people came to mind when you were answering this question?

4.7. How often do you have access to someone who can answer questions that you might have about your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4u. In your own words, what is this question asking?

Probe 4v. Which types of people came to mind when you were answering this question? (doctors or non-health professionals?)

Probe 4w. How often do you have questions about your diabetes?

Probe 4x. If you don't often have questions about your diabetes, how did you choose an answer when I asked about your access to people who could respond to any questions you may have?

4.8. How often do you have access to someone who you can turn to for suggestions about how to deal with a personal problem related to diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4y. How did you choose your answer to this question? How did you decide to pick (most of the time) instead of (some of the time) or (all of the time)? (If needed: Did you count the number of times that someone gave you suggestions, or did you use another method?)

Probe 4z. Which types of people came to mind when I said "someone who you can turn to"?

Probe 4aa. What did you think of when I said, "a personal problem related to diabetes"?

Probe 4bb. How often do you have these personal problems related to your diabetes?

4.9. How often do you have access to someone who can take you to the doctor if you needed it because of your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4cc. When you heard the question, during what type of situations did you think you may need help to get to the doctor? (For example, were you thinking of someone who could take you to the doctor only during emergencies or for routine medical visits?)

4.10. How often do you have access to someone who could prepare your meals if you were unable to do so yourself because of your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4dd. When you chose the answer, how many different meal options were you thinking of?

Probe 4ee. From where do you get your meals? (For example, does someone else cook for you, do you cook yourself or do you eat all your meals at chopbars, restaurants, etc. or some combination of the above?)

Probe 4ff. How often do you get your meals from this source?

Probe 4gg. If you sometimes cook yourself, how often are you unable to do so because of the diabetes?

4.11. How often do you have access to someone who could help with daily chores if you were sick because of your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4hh. How did you choose your answer to this question? How did you decide to pick (answer given) instead of (next lowest answer) or (next highest answer)? (If needed: Did you count the number of times that someone helped with your chores or did you use another method?)

Probe4ii. What comes to mind when you hear "daily chores"?

Probe 4jj. In your own words, what does it mean to be sick because of your diabetes?

4.12. How often do you have access to someone who can help you pay for your diabetes medical costs? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4kk. What types of diabetes medical costs came to mind as you were answering the question?

Probe 4ll. How often do you need help with paying your diabetes medical costs?

Probe 4mm. If you need help with paying for diabetes medical costs, how did you decide which answer to choose?

Probe 4nn. If you don't need help with paying for diabetes medical costs, how did you decide which answer to choose?

4.13. How often do you have access to someone who can help you if you were confined to bed because of your diabetes? Would you say someone is available none of the time, a little of the time, some of the time, most of the time or all of the time?

Probe 4oo. What does the term “confined to bed” mean to you? Please remember there is no wrong or right answer to the question.

5. We are interested in your experiences with family members, friends and other kinds of people. There are no right or wrong answers to any of these questions, so please share whatever answers come to mind.

5.1. How often do people think that you cannot fulfill your responsibilities because you have diabetes? These responsibilities may be work or family related. Would you say very often, often, sometimes, rarely or never?

Probe 5a. What kind of responsibilities came to mind when I asked the question?

Probe 5b. What types of people came to mind when I asked the question?

5.2. How often do people exclude you from social gatherings that involve food or drink they think you shouldn't have because you have diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5c. In your own words, what is this question asking?

Probe 5d. If something happens “very often”, what does that mean to you?

Probe 5e. If something happens “often”, what does that mean to you?

Probe 5f. What is the difference between “very often” and “often”? Which one is more frequent, “very often” or “often”?

5.3. When you are at home, how often do some people restrict food or drink they think you shouldn't have because you have diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5g. What does it mean if someone "restricts food or drink they think you shouldn't have"?

5.4. How often have romantic partners rejected you because of your diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5h. What came to mind when you heard the phrase "romantic partners rejected you"?

(What kinds of people were you thinking of?)

Probe 5i. If your romantic partner rejects you "very often", what does that mean?

Probe 5j. If your romantic partner rejects you "often", what does that mean?

Probe 5k. How many romantic partners have you had since you were diagnosed with diabetes? And have any of them rejected you because you have diabetes? Were you thinking of one romantic partner when you answered this question or all the romantic partners you have had since you were diagnosed with diabetes?

5.5. How often have close friends and family avoided you because you have diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5l. How often have close friends and family avoided you for other reasons?

Probe 5m. How often have close friends and family avoided you because you have diabetes?

5.6. How often have others who do not know you well avoided you because you have diabetes? Think of situations outside of the clinic with people like coworkers or neighbors with whom you interact who are not close friends. Would you say very often, often, sometimes, rarely or never?

Probe 5n. How did you interpret the phrase "avoided you because you have diabetes"?

Probe 5o. What types of people came to mind when you were answering this question?

5.7. How often do some people treat you like you're "sick" or "ill" because you have diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5p. What were some of the experiences that came to mind when you were answering the question?

Probe 5q. When thinking about how people treated you, what did the term "often" mean to you?

Probe 5r. When thinking about how people treated you, what did the term "rarely" mean to you?

5.8. How often do people mistake you for having HIV or AIDS because of your diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5s. What does it mean if someone mistakes you "for having HIV or AIDS"?

Probe 5t. How do you feel about this question?

5.9. How often do you think that people talk about you behind your back because of your diabetes? Would you say: always, very often, sometimes, rarely or never?

Probe 5u. What does "talk about you behind your back" mean to you?

Probe 5v. What types of people came to mind when you were answering the question?

5.10. How often do some people see you as a lesser person because you have diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5w. How did you choose your answer to this question? How did you decide to pick (answer given) instead of (next lowest answer) or (next highest answer)?

Probe 5x. What types of people came to mind when you were answering the question?

Probe 5y. What does "a lesser person" mean to you?

5.11. How often have you been discriminated against in the workplace because of your diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5z. What does "discriminated against in the workplace" mean to you?

Probe 5aa. What types of people came to mind when you were answering the question?

5.12. How often do you feel embarrassed in social situations because of your diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5bb. Can you please tell me about the last time when you felt embarrassed because of your diabetes?

5.13. How often do you feel ashamed of having diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5cc. What were you thinking about as you answered the question?

Probe 5dd. During what types of situations "do you feel ashamed of having diabetes"?

5.14. How often do you blame yourself for having diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5ee. In your own words, what does this question mean?

5.15. How often do you feel guilty for having diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5ff. What types of experiences came to mind when you thought about feeling guilty for having diabetes?

Probe 5gg. How did you decide to pick (answer given) instead of (next lowest answer) or (next highest answer)?

5.16. How often do you feel like a failure because you have diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5hh. What does "feel like a failure because you have diabetes" mean to you?

Probe 5ii. You said you feel like a failure "often". How many different events did you recall as you were thinking about your answer?

5.17. How often do you feel like you are not good enough because you have diabetes? Would you say very often, often, sometimes, rarely or never?

Probe 5jj. In your own words, what is this question asking?

5.18. How often have you been told that you brought your diabetes on yourself? Would you say always, very often, sometimes, rarely or never?

Probe 5kk. What does it mean to you to bring "diabetes on yourself"? How might someone bring on diabetes?

Probe 5ll. If someone is always told that he or she brought diabetes on himself or herself, on average, how many times does this happen?

5.19. How often do you think that some people judge you for your food choices because you have diabetes? Would you say always, very often, sometimes, rarely or never?

Probe 5mm. How many incidents came to mind when you were thinking of the times during which people judged you for your food choices because you have diabetes?

Probe 5nn. What does "people judge you for your food choices" mean to you?

Probe 5oo. When was the last time someone judged you for your food choice because of your diabetes? Can you tell me what happened at the time?

5.20. How often have close friends or family members said something that made you feel bad about yourself because of your diabetes? Would you say always, very often, sometimes, rarely or never?

Probe 5pp. What kinds of things do people say that make you/might make someone feel bad because you/that person have/has diabetes?

Probe 5qq. What does it mean to you to "feel badly about yourself because of your diabetes"?

5.21. How often have health professionals said something that made you feel bad about yourself because of your diabetes? Would you say always, very often, sometimes, rarely or never?

Probe 5rr. Who came to mind when you heard the term "health professionals"?

Probe 5ss. How did you choose your answer to this question? How did you decide to pick (answer given) instead of (next lowest answer) or (next highest answer)? (If needed: Did you count the number of times that someone said something, or did you use another method?)

5.22. How often have others who do not know you well said something that made you feel bad about yourself because of your diabetes? Would you say always, very often, sometimes, rarely or never?

Probe 5tt. What types of people came to mind when you were answering this question?

5.23. How often do health professionals think that people with diabetes don't know how to take care of themselves? Would you say always, very often, sometimes, rarely or never?

Probe 5uu. What does "take care of yourself" mean to you in this question?

5.24. How often do other people think that your diabetes is infectious? Would you say always, very often, sometimes, rarely (not often) or never?

Probe 5vv. What does the term "infectious" mean to you?

Probe 5ww. What types of people came to mind as you were answering this question?

5.25. How often do you think that people avoid you because they think you are cursed because of your diabetes? Would you say: always, very often, sometimes, rarely or never?

Probe 5xx. How did you choose your answer to this question? How did you decide to pick (answer given) instead of (next lowest answer) or (next highest answer)? (If needed: Did you count the number of times that someone said something, or did you use another method?)

Probe 5yy. What does it mean to you when "someone is cursed because of their diabetes"?

Probe 5zz. What types of people came to mind as you were answering this question?

5.26. How often do you think that those with diabetes are teased? Would you say: always, very often, sometimes, rarely or never?

Probe 5aaa. If "someone with diabetes is teased", what does that mean to you?

Ok, we'll move on to other questions.

6. In addition to seeing a doctor for diabetes treatment, how often do you visit an herbalist to get help for your diabetes? Would you say always, very often, sometimes, rarely or never?

Probe 6a. Who comes to mind when you hear the term "herbalist"?

Probe 6b. If someone tells you that they visit the herbalist "very often", on average how many times do you think he/she sees the herbalist?

Probe 6c. If someone tells you that they visit the herbalist "sometimes", on average how many times do you think he/she sees the herbalist?

Probe 6d. What, if anything, do you think will make it difficult for other people with diabetes to answer this question?

Probe 6e. Do you think that most people who have diabetes would give an honest answer about going to an herbalist?

Probe 6f. What, if anything, do you think we can say to make people feel more comfortable answering this question honestly?

7. In addition to seeing a doctor for diabetes treatment, how often do you visit a spiritualist to get help for your diabetes? Would you say always, very often, sometimes, rarely or never?

Probe 7a. What types of people did you think about when you heard the term "spiritualist"?

Probe 7b. How do you decide when to see the doctor or when to see the spiritualist?

Probe 7c. Do you think that most people who have diabetes would give an honest answer about going to a spiritualist?

Probe 7d. What, if anything, do you think we can say to make people feel more comfortable answering this question honestly?

8. What, if any, religion do you identify with? Would you say that you are:

☐ A CHRISTIAN → **GO TO Q9**
☐ A MUSLIM → **GO TO Q9**
☐ A TRADITIONALIST, MEANING YOU PRACTICE A TRADITIONAL AFRICAN RELIGION → **GO TO Q9**
☐ YOU PRACTICE SOME OTHER TYPE OF RELIGION. **ASK:** WHAT TYPE OF RELIGION DO YOU IDENTIFY WITH? **WRITE ANSWER ON LINE]** _____ → **GO TO Q9**
☐ YOU DO NOT IDENTIFY WITH ANY RELIGION → **GO TO Q11**

☐ DOES NOT KNOW → **GO TO Q11**
☐ REFUSED → **GO TO Q11**

9. In general, how often do you go to religious services? Would you say:

☐ NEVER → **GO TO Q11**
☐ ONCE OR TWICE A YEAR → **GO TO Q10**
☐ SEVERAL TIMES A YEAR → **GO TO Q10**
☐ ONCE OR TWICE A MONTH → **GO TO Q10**
☐ SEVERAL TIMES A MONTH → **GO TO Q10**
☐ ONCE OR TWICE A WEEK → **GO TO Q10**
☐ SEVERAL TIMES A WEEK → **GO TO Q10**
☐ EVERY DAY → **GO TO Q10**

☐ DOES NOT KNOW → **GO TO Q11**
☐ REFUSED → **GO TO Q11**

Probe 9a. What problems, if any, did you have when deciding which answer to choose?

10. Now, I have some questions about your religious involvement. I will read some statements and then ask what you think of each statement.

10.1. I feel like I really belong in my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?

Probe 10a. What does it mean to you to "belong in your place of worship"?

Probe 10b. In your own words, can you explain what it means to (agree) with a statement?

Probe 10c. In your own words, can you explain what it means to (strongly agree) with a statement?

10.2. Being a member of my place of worship is an important part of who I am. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?

Probe 10d. In your own words, what does this question mean?

10.3. I feel welcomed in my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?

Probe 10e. To you, what is the difference, if any, between "feeling welcomed" and "belonging to your place" of worship?

Prove 10f. Can you please provide an example of a time when you felt welcomed in your place of worship?

10.4. I feel I am accepted by the people in my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?

Probe 10g. Which type of people were you thinking of when you answered the question?

Probe 10h. What kinds of things would make you feel accepted in your place of worship?

10.5. I feel as though the people in my place of worship care about me. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?

Probe 10i. How did you choose your answer to this question?

Probe 10j. What kinds of things do people in your place of worship do to show that they "care for you/someone?

10.6. I feel I am a valued member at my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?

Probe 10k. What does the term "valued member" mean to you?

10.7. I feel like my opinion matters at my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?

Probe 10l. What were you thinking about when you answered this question?

Probe 10m. What types of issues came to mind when you were thinking about how your opinion matters?

Let's talk a bit about your income.

11. Including salaries, self-employment, social security payments, if applicable, monies that family members give you regularly, and any other source of income, which of the following income categories best represents your monthly **household** income on average? Would you say:

☐ LESS THAN 200 GHANA CEDIS
☐ 200-499 GHANA CEDIS
☐ 500-999 GHANA CEDIS
☐ 1000-4999 GHANA CEDIS
☐ 5000-9999 GHANA CEDIS
☐ MORE THAN 10,000 GHANA CEDIS

☐ DOES NOT KNOW
☐ REFUSED

Probe 11a. What sources of income came to mind as you answered the question?

Probe 11b. How did you calculate the average monthly household income?

Probe 11c. Was there anything confusing about this question?

Probe 11d. Do you think that most people who have diabetes would give an honest answer about their income?

Probe 11e. What, if anything, do you think we can say to make people feel more comfortable answering this question honestly?

12. Including salaries, self-employment, social security payments, if applicable, monies that family members give you regularly, and any other source of income, on average how much do you yourself earn each month? Would you say:

☐ LESS THAN 200 GHANA CEDIS
☐ 200-499 GHANA CEDIS
☐ 500-999 GHANA CEDIS
☐ 1000-4999 GHANA CEDIS
☐ 5000-9999 GHANA CEDIS
☐ MORE THAN 10,000 GHANA CEDIS

☐ DOES NOT KNOW
☐ REFUSED

Probe 12a. How is this income question different from the last one I asked?

Probe 12b. What are "social security payments"?

We are done with this interview. Thank you so much for your time.

PROCEED TO INCENTIVE PROCESS.

APPENDIX B

TYPE 2 DIABETES AND SOCIAL NETWORKS QUESTIONNAIRE (ENGLISH VERSION)

Formatting Key:

Text in ALL CAPS or grey shading = Information for interviewer
Text in sentence case and all caps = Interviewer reads text aloud to study participants

INTERVIEWER/STUDY INFO:

INTERVIEWER NAME: _____

INTERVIEW DATE: _____

PATIENT NAME: _____

AGE: _____

TYPE 2 DIABETES FOR ONE YEAR OR MORE: _____

KATH FILE NO: _____

LANGUAGE FOR SURVEY ADMINSTRATION: _____

READ THE INFO BELOW TO STUDY PARTICPANT

In this study, we are interested in learning about your type 2 diabetes, your medical history, your religion, if any, and your background. We are also interested in learning about some of the people in your life and your relationships with them. Please try to provide the most honest and accurate answers that you can.

MEDICAL HISTORY AND HEALTH RESOURCE ACCESS

1. For how many years have you had type 2 diabetes?
   [**WRITE THE RESPONSE ON THE LINE BELOW OR PLACE A CHECK MARK IN THE APPROPRIATE BOX**]
   _____ years

   ☐ DOES NOT KNOW
   ☐ REFUSED

2. Do any of your parents, sisters, brothers, grandparents or other blood relatives have type 2 diabetes?
   ☐ YES
   ☐ NO

   ☐ DOES NOT KNOW
   ☐ REFUSED

3. Do you currently have health insurance?
   ☐ YES → **GO TO Q4**
   ☐ NO → **GO TO Q5**

   ☐ DOES NOT KNOW → **GO TO Q5**
   ☐ REFUSED → **GO TO Q5**

4. Which of the following expenses are currently covered by your health insurance? Please indicate all that apply. Does your health insurance cover:

   [**CHECK ALL THAT APPLY**]
   ☐ DIABETES MEDICINES
   ☐ INSULIN
   ☐ OTHER MEDICINES
   ☐ CONSULTATION FEES
   ☐ DIAGNOSTIC TESTS, FOR EXAMPLE LAB WORK AND X-RAYS
   ☐ OUT-PATIENT DEPARTMENT SERVICES
   ☐ IN-PATIENT SERVICES

   ☐ DOES NOT KNOW
   ☐ REFUSED

5. In some communities in Ghana, people who are sick see **a doctor and use traditional medicine** at the same time. How often do people in your community often see **a doctor and also use traditional medicine from herbalists** when they have a disease like diabetes? Would you say:
   ☐ ALWAYS
   ☐ VERY OFTEN
   ☐ SOMETIMES
   ☐ RARELY
   ☐ NEVER

   ☐ DOES NOT KNOW
   ☐ REFUSED

6. And what about you? In addition to seeing a doctor for diabetes treatment, how often do you visit **a herbalist** to get help for your diabetes? Would you say:
   ☐ ALWAYS
   ☐ VERY OFTEN
   ☐ SOMETIMES
   ☐ RARELY
   ☐ NEVER

   ☐ DOES NOT KNOW
   ☐ REFUSED

7. In some communities in Ghana, people who are sick see **a doctor and visit a spiritualist** at the same time. How often do people in your community often see **a doctor and also see a spiritualist** when they have a disease like diabetes? Would you say:
   ☐ ALWAYS
   ☐ VERY OFTEN
   ☐ SOMETIMES
   ☐ RARELY
   ☐ NEVER

   ☐ DOES NOT KNOW
   ☐ REFUSED

8. And what about you? In addition to seeing a doctor for diabetes treatment, how often do you visit **a spiritualist** to get help for your diabetes? Would you say:
   ☐ ALWAYS
   ☐ VERY OFTEN
   ☐ SOMETIMES
   ☐ RARELY
   ☐ NEVER

   ☐ DOES NOT KNOW
   ☐ REFUSED

9. In addition to seeing a doctor for diabetes treatment, how often do you visit **a fetish priest** to get help for your diabetes? Would you say:
   ☐ ALWAYS
   ☐ VERY OFTEN
   ☐ SOMETIMES
   ☐ RARELY
   ☐ NEVER

   ☐ DOES NOT KNOW
   ☐ REFUSED

10. Has a doctor or other healthcare professional ever told you that you have any of the following medical conditions?

MEDICAL CONDITION	YES	NO	NOT SURE
Hypertension or high blood pressure			
Stroke			
A heart condition such as a heart attack or heart failure			
Tuberculosis or TB			
HIV or AIDS			

RELIGION AND RELIGIOUS PARTICIPATION

The next questions are about your religious activities.

11. What, if any, religion do you identify with? Would you say that you are:
    - ☐ A CHRISTIAN → **GO TO Q12**
    - ☐ A MUSLIM → **GO TO Q13**
    - ☐ A TRADITIONALIST, MEANING YOU PRACTICE A TRADITIONAL AFRICAN RELIGION → **GO TO Q13**
    - ☐ YOU PRACTICE SOME OTHER TYPE OF RELIGION. **ASK:** WHAT TYPE OF RELIGION DO YOU IDENTIFY WITH? **WRITE ANSWER ON LINE**] _____ → **GO TO Q13**
    - ☐ YOU DO NOT IDENTIFY WITH ANY RELIGION → **GO TO Q18**

    - ☐ DOES NOT KNOW
    - ☐ REFUSED

12. With which denomination do you primarily identify? Would you say you are:
    - ☐ PRESBYTERIAN
    - ☐ METHODIST
    - ☐ CATHOLIC
    - ☐ ANGLICAN
    - ☐ PENTECOSTAL
    - ☐ BAPTIST
    - ☐ SEVENTH DAY ADVENTIST
    - ☐ JEHOVAH'S WITNESS
    - ☐ SOME OTHER DENOMINATION
      ASK: What type of denomination is this? **[WRITE THE ANSWER ON LINE**] _____

    - ☐ DOES NOT IDENTIFY WITH A SPECIFIC DENOMINATION
    - ☐ DOES NOT KNOW
    - ☐ REFUSED

13. In general, how often do you go to religious services? Would you say:
    - ☐ NEVER
    - ☐ ONCE OR TWICE A YEAR
    - ☐ SEVERAL TIMES A YEAR
    - ☐ ONCE OR TWICE A MONTH
    - ☐ SEVERAL TIMES A MONTH
    - ☐ ONCE OR TWICE A WEEK
    - ☐ SEVERAL TIMES A WEEK
    - ☐ EVERY DAY

    - ☐ DOES NOT KNOW
    - ☐ REFUSED

14. Besides religious services, how often do you take part in other activities at a place of worship? Would you say:
    - ☐ NEVER
    - ☐ ONCE OR TWICE A YEAR
    - ☐ SEVERAL TIMES A YEAR
    - ☐ ONCE OR TWICE A MONTH
    - ☐ SEVERAL TIMES A MONTH
    - ☐ ONCE OR TWICE A WEEK
    - ☐ SEVERAL TIMES A WEEK
    - ☐ EVERY DAY

    - ☐ DOES NOT KNOW
    - ☐ REFUSED

15. How often do you take part in Bible study groups, religious prayer meetings, or other religious activities somewhere other than a place of worship? Would you say:
    - ☐ NEVER
    - ☐ ONCE OR TWICE A YEAR
    - ☐ SEVERAL TIMES A YEAR
    - ☐ ONCE OR TWICE A MONTH
    - ☐ SEVERAL TIMES A MONTH
    - ☐ ONCE OR TWICE A WEEK
    - ☐ SEVERAL TIMES A WEEK
    - ☐ EVERY DAY

    - ☐ DOES NOT KNOW
    - ☐ REFUSED

16. How often do you take part in volunteer activities that are organized by your religious group? Would you say:

☐ NEVER
☐ ONCE OR TWICE A YEAR
☐ SEVERAL TIMES A YEAR
☐ ONCE OR TWICE A MONTH
☐ SEVERAL TIMES A MONTH
☐ ONCE OR TWICE A WEEK
☐ SEVERAL TIMES A WEEK
☐ EVERY DAY

☐ DOES NOT KNOW
☐ REFUSED

SENSE OF BELONGING

SKIP THIS IF PARTICIPANT RESPONDED "NEVER" TO Q13 ABOUT RELIGIOUS SERVICES

17. To what extent do you agree or disagree with the following statements? [**PLACE A TICK ✓ IN THE APPROPRIATE BOX**]

		STRONGLY DISAGREE	**DISAGREE**	**AGREE**	**STRONGLY AGREE**
a.	I feel like I really belong in my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?				
b.	Being a member of my place of worship is an important part of who I am. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?				
c.	I feel welcome in my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?				
d.	I feel I am accepted by the people in my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?				
e.	I feel as though others in my place of worship care about me. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?				
f.	I feel I am a valued member at my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?				
g.	I feel like my opinion matters at my place of worship. Would you say you strongly disagree, disagree, agree or strongly agree with this statement?				

SOCIAL NETWORKS

The next questions ask about some of the people in your life and your relationships with them.

18. Please name up to three people with whom you have discussed matters that are important to you within the past 6 months. You can provide a first name or a nickname instead of their real names if you prefer. [**WRITE EACH GIVEN NAME ON A SEPARATE LINE**]

Person 1: _____
Person 2: _____
Person 3: _____

☐NOBODY → Just to confirm, there is nobody in your life with whom you discuss important matters.

→ **IF PARTICIPANT CONFIRMS THERE IS NOBODY, GO TO Q19.**

→ **IF THERE ARE PEOPLE, THEN SAY**: please name up to three people with whom you have discussed matters that are important to you within the past 6 months. [**WRITE ANSWERS ON LINES ABOVE**]

19. Please name up to three people who have helped you by performing various daily tasks such as shopping, preparing your food, cleaning, washing your clothes or things that you need to do at home within the past 6 months. You can provide a first name or a nickname instead of their real names if you prefer. [**WRITE EACH GIVEN NAME ON A SEPARATE LINE**]

Person 4: _____
Person 5: _____
Person 6: _____

→ **IF PARTICIPANT MENTIONS A NAME THAT WAS LISTED IN Q18, ASK**: Is this the same person you discuss important matters with

→ **IF IT'S THE SAME PERSON, WRITE THE NAME AGAIN.**

→ **IF IT'S A DIFFERENT PERSON, ASK**: Can you please provide a second name for this person so we don't mix him/her up with the person you already mentioned?

☐NOBODY → Just to confirm, there is nobody in your life who helps you with various daily tasks.

→ **IF PARTICIPANT CONFIRMS THERE IS NOBODY, GO TO Q20.**

→ **IF THERE ARE PEOPLE, THEN SAY**: Please name up to three people who have helped you by performing various daily tasks such as shopping, preparing your food, cleaning, washing your clothes or things that you need to do at home within the past 6 months. [**WRITE ANSWERS ON LINES ABOVE**] **COPY THE NAMES PROVIDED ABOVE INTO THE NUMBERED SPACES ON PAGE 10 BEFORE ASKING THE NEXT QUESTION.**

20. Now, let’s talk about the people you have just named. [**FOR EACH PERSON, OBTAIN ANSWERS FOR QUESTIONS 20a-20g BEFORE GOING TO THE NEXT PERSON**] Let’s start with [**PERSON 1**]. **WHEN DONE, SAY**: Let’s move on to [**PERSON 2**], **ETC**.

		PERSON 1	PERSON 2	PERSON 3	PERSON 4	PERSON 5	PERSON 6
	NAMES						
a.	Is [**PERSON**] male or female?	☐MALE ☐FEMALE	☐MALE ☐FEMALE	☐MALE ☐FEMALE	☐MALE ☐FEMALE	☐MALE ☐FEMALE	☐MALE ☐FEMALE
b.	Is [**PERSON**] your: a. Husband or wife (HUB/WIFE) b. Son or daughter (SON/DAU) c. Relative d. Friend or e. Other	☐HUB/WIFE ☐ SON/DAU ☐RELATIVE ☐FRIEND ☐OTHER	☐HUB/WIFE ☐ SON/DAU ☐RELATIVE ☐FRIEND ☐OTHER	☐HUB/WIFE ☐ SON/DAU ☐RELATIVE ☐FRIEND ☐OTHER	☐HUB/WIFE ☐ SON/DAU ☐RELATIVE ☐FRIEND ☐OTHER	☐HUB/WIFE ☐ SON/DAU ☐RELATIVE ☐FRIEND ☐OTHER	☐HUB/WIFE ☐ SON/DAU ☐RELATIVE ☐FRIEND ☐OTHER
c.	Do you currently live in the same house as [**PERSON**]?	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO
d.	Does [**PERSON**] usually go to religious services with you? [**ONLY ASK IF STUDY PARTICIPANT GOES TO RELIGIOUS SERVICES**]	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO
e.	What is the highest level of education that [**PERSON**] has completed? Has he/she completed primary education, JHS, SHS, University or did [**PERSON**] not go to school? **PRIM ED.=PRIMARY EDUCATION** **DK=DON’T KNOW**	☐PRIM ED. ☐JHS ☐SHS ☐ UNIVER-SITY ☐NONE ☐DK	☐PRIM ED. ☐JHS ☐SHS ☐UNIVER-SITY ☐NONE ☐DK	☐PRIM ED. ☐JHS ☐SHS ☐UNIVER-SITY ☐NONE ☐DK	☐PRIM ED. ☐JHS ☐SHS ☐UNIVER-SITY ☐NONE ☐DK	☐PRIM ED. ☐JHS ☐SHS ☐UNIVER-SITY ☐NONE ☐DK	☐PRIM ED. ☐JHS ☐SHS ☐UNIVER-SITY ☐NONE ☐DK
f.	Does [**PERSON**] know that you have T2D?	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO	☐YES ☐NO
g.	Does [**PERSON**] also have T2D? **DK=DON’T KNOW**	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK

21. Which one of the people we have just talked about, if any, helps you the most in caring for your diabetes? **[WRITE DOWN THE NAME AND TYPE OF PERSON (I.E. SPOUSE, RELATIVE, FRIEND OR OTHER) ON THE LINE PROVIDED. IF STUDY PARTICIPANT INSISTS THERE IS MORE THAN 1 PERSON, WRITE ONLY 2 NAMES.]**

_____

☐ NONE OF THEM HELPED THE STUDY PARTICIPANT THE MOST

COPY THE NAMES FROM THE SOCIAL NETWORKS PAGE (P. 9) INTO THE SPACES PROVIDED IN THE TABLE BELOW. [PLACE A TICK ✓ IN THE APPROPRIATE BOX]

22. **AN EXAMPLE: Does [PERSON 1] have a relationship with [PERSON 2] as a friend, family member or some other type of connection? Does [PERSON 1] have a relationship with [PERSON 3] as a friend, family member or some other type of connection? Does [PERSON 1] have a relationship with [PERSON 4] as a friend, family member or some other type of connection? Does [PERSON 1] have a relationship with [PERSON 5] as a friend, family member or some other type of connection? Does [PERSON 1] have a relationship with [PERSON 6] as a friend, family member or some other type of connection?**

DK=STUDY PARTICIPANT DOES NOT KNOW IF THE TWO PEOPLE IN QUESTION ARE CONNECTED.

	PERSON 1	PERSON 2	PERSON 3	PERSON 4	PERSON 5	PERSON 6
PERSON 1		☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK
PERSON 2			☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK
PERSON 3				☐YES ☐NO ☐DK	☐YES ☐NO ☐DK	☐YES ☐NO ☐DK
PERSON 4					☐YES ☐NO ☐DK	☐YES ☐NO ☐DK
PERSON 5						☐YES ☐NO ☐DK

SOCIAL SUPPORT

23. Outside of a clinic environment, we know that people sometimes look to their friends, family members or others they know for companionship, assistance, or other types of help. [**PLACE A TICK ✓ IN THE APPROPRIATE BOX**]

		NONE OF THE TIME	A LITTLE OF THE TIME	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME
a.	Outside of a clinic environment, how often do you have access to someone who you can count on to listen to you when you need to talk about your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
b.	Outside of a clinic environment, how often do you have access to someone who can share your most private worries and fears about diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
c.	Outside of a clinic environment, how often do you have access to someone who can give you good advice about a crisis related to your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
d.	Outside of a clinic environment, how often do you have access to someone who you can confide in or talk to about problems with your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
e.	Outside of a clinic environment, how often do you have access to someone who can understand your problems with diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
f.	Outside of a clinic environment, how often do you have access to someone whose advice you really want about your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					

	Q23 CONTINUED	NONE OF THE TIME	A LITTLE OF THE TIME	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME
g.	Outside of a clinic environment, how often do you have access to someone who can answer questions that you might have about your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
h.	Outside of a clinic environment, how often do you have access to someone who you can turn to for suggestions about how to deal with a personal problem related to diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
i.	How often do you have access to someone who can help you if you were confined to bed because of your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
j.	How often do you have access to someone who can take you to the doctor if you needed it because of your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
k.	How often do you have access to someone who could prepare your meals if you were unable to do so yourself because of your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
l.	How often do you have access to someone who could help with daily chores if you were sick because of your diabetes? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					
m.	How often do you have access to someone who can help you pay for your diabetes medical expenses? Would you say such a person is available none of the time, a little of the time, some of the time, most of the time or all of the time?					

STIGMA

24. As a person with diabetes, we are interested in your experiences with family members, friends and others in society. For some of these questions, we are interested in your impressions/perceptions. [**PLACE A TICK ✓ IN THE APPROPRIATE BOX**]

		NEVER	RARELY	SOMETMES	OFTEN	VERY OFTEN
a.	How often do people think that you cannot fulfill your responsibilities because you have diabetes? These responsibilities may be work or family related. Would you say very often, often, sometimes, rarely or never?					
b.	How often do some people exclude you from social gatherings that involve food or drink they think you shouldn't have because you have diabetes? Would you say very often, often, sometimes, rarely or never?					
c.	When you are at home, how often do some people restrict food or drink they think you shouldn't have because you have diabetes? Would you say very often, often, sometimes, rarely or never?					
d.	How often have you been rejected by romantic partners because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
e.	How often have you been avoided by close friends and family because you have diabetes? Would you say very often, often, sometimes, rarely or never?					
f.	How often have you been avoided by others who do not know you well because you have diabetes? Think of people like coworkers or neighbors with whom you interact who are not close friends. Would you say very often, often, sometimes, rarely or never?					
g.	How often do some people treat you like you're "sick" or "ill" because you have diabetes? Would you say very often, often, sometimes, rarely or never?					

Q24 CONTINUED		NEVER	RARELY	SOMETMES	OFTEN	VERY OFTEN
h.	How often do people mistake you for having HIV/AIDS because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
i.	How often do some people see you as a lesser person or look down on you because you have diabetes? Would you say very often, often, sometimes, rarely or never?					
j.	How often have you been discriminated against in the workplace because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
k.	How often do you feel embarrassed in social situations because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
l.	How often do you feel ashamed of having diabetes? Would you say very often, often, sometimes, rarely or never?					
m.	How often do you blame yourself for having diabetes? Would you say very often, often, sometimes, rarely or never?					
n.	How often do you feel guilty for having diabetes? Would you say very often, often, sometimes, rarely or never?					
o.	How often do you feel like a failure because you have diabetes? Would you say very often, often, sometimes, rarely or never?					
p.	How often do you feel like you are not good enough because you have diabetes? Would you say very often, often, sometimes, rarely or never?					
q.	How often have you been told that you brought your diabetes on yourself? Would you say very often, often, sometimes, rarely or never?					
r.	How often do you think that some people judge you for your food choices because you have diabetes? Would you say very often, often, sometimes, rarely or never?					

Q24 CONTINUED		NEVER	RARELY	SOMETMES	OFTEN	VERY OFTEN
s.	How often have close friends or family members said something that made you feel bad about yourself because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
t.	How often have health professionals said something that made you feel bad about yourself because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
u.	How often have others who do not know you well said something that made you feel bad about yourself because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
v.	How often do health professionals think that people with diabetes don't know how to take care of themselves? Would you say always, very often, sometimes, rarely or never?					
w.	How often do you think that other people think that your diabetes is infectious? Would you say very often, often, sometimes, rarely or never?					
x.	How often do you think that people avoid you because they think you are cursed because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
y.	How often do you think that those with diabetes are teased Would you say very often, often, sometimes, rarely or never?					
z.	How often do you think that people talk about you behind your back because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
aa.	How often you do think that people assume you must be overweight, or have been in the past because of your diabetes? Would you say very often, often, sometimes, rarely or never?					
bb.	When you are at social gatherings, how often do some people restrict food or drink they think you shouldn't have because you have diabetes? Would you say very often, often, sometimes, rarely or never?					

DEMOGRAPHIC QUESTIONS

I have just a few more questions for you. The information you provide will help us describe the group of people who participated in the study. [**PLACE A TICK ✓ IN THE APPROPRIATE BOX**]

25. What is your current relationship or marital status? Are you:
    - ☐ SINGLE (MEANING YOU HAVE NEVER BEEN MARRIED)
    - ☐ MARRIED
    - ☐ LIVING AS MARRIED/COHABITING
    - ☐ DIVORCED/SEPARATED
    - ☐ WIDOWED

    - ☐ DOES NOT KNOW
    - ☐ REFUSED

26. Do you have any children?
    - ☐ YES
    - ☐ NO

    - ☐ DOES NOT KNOW
    - ☐ REFUSED

27. Please tell me about your current living situation:

		YES	NO	N/A
a.	Do you currently live alone? **[IF YES, GO TO 28; IF NO, GO TO 27b.]**			
b.	**[DO NOT ASK IF PARTICIPANT IS SINGLE/WIDOWED/DIVORCED; SELECT N/A]** Do you currently live in the same house with a husband, wife or significant other?			
c.	**[DO NOT ASK IF PARTICIPANT DOES NOT HAVE CHILDREN; SELECT N/A]** Do you currently live in the same house with sons or daughters who are 18 years or older?			
d.	**[DO NOT ASK IF PARTICIPANT DOES NOT HAVE CHILDREN; SELECT N/A]** Do you currently live in the same house with sons or daughters who are less than 18 years old?			
e.	Do you currently live in the same house with anyone else under the age of 18 years?			
f.	Do you currently live in the same house with one or both of your parents?			
g.	Do you currently live in the same house with other adult relatives?			
h.	Do you currently live in the same house with other adults who are not related to you? Do not include your partner.			

28. What is the ethnicity that you primarily identify with? Are you:
☐ ASANTE (AKAN)
☐ FANTE (AKAN)
☐ GA
☐ GA-ADANGME
☐ EWE
☐ GUAN
☐ MOLE-DAGBANI
☐ GRUSSI
☐ SOME OTHER ETHNICITY
ASK: What is your ethnicity? **[WRITE THE ANSWER ON LINE]**
_____

☐ DOES NOT KNOW
☐ REFUSED

29. What is the highest level of education that you have completed? Would you say that you have:
☐ NO FORMAL EDUCATION
☐ COMPLETED PRIMARY EDUCATION OR LESS THAN 6 YEARS OF SCHOOL
☐ COMPLETED JHS OR JSS [MIDDLE SCHOOL]
☐ COMPLETED SHS OR SSS [HIGH SCHOOL]
☐ A VOCATIONAL, TECHNICAL OR COMMUNITY COLLEGE POST SECONDARY DIPLOMA OR HND
☐ A BACHELOR DEGREE
☐ A POST GRADUATE DEGREE

☐ DOES NOT KNOW
☐ REFUSED

30. What is your current work status? Please indicate all that apply. Are you:
☐ EMPLOYED FULL-TIME
☐ EMPLOYED PART-TIME
☐ A HOUSEWIFE/HOMEMAKER
☐ UNEMPLOYED
☐ RETIRED
☐ A STUDENT
☐ OTHER
ASK: What is your current work status? **[WRITE THE ANSWER ON LINE]** _____

☐ DOES NOT KNOW
☐ REFUSED

31. Including salaries, self-employment, social security or pension benefits, if applicable, monies that family members give you regularly, and any other source of income, which of the following income categories best represents your monthly income on average? Would you say:
☐ LESS THAN 200 GHANA CEDIS
☐ 200-499 GHANA CEDIS
☐ 500-999 GHANA CEDIS
☐ 1000-4999 GHANA CEDIS
☐ 5000-9999 GHANA CEDIS
☐ 10,000 GHANA CEDIS OR MORE

☐ DOES NOT KNOW
☐ REFUSED

32. Do you currently live in Kumasi?
☐ YES → **GO TO FINAL MESSAGE AT END OF PAGE**
☐ NO → **GO TO 33**

☐ DOES NOT KNOW
☐ REFUSED

33. Please tell me the name of the town and region in which you currently live. **[WRITE DOWN THE RESPONSE ON THE LINES BELOW. LET PARTICIPANT IDENTIFY REGION EVEN IF YOU KNOW IT.]**
NAME OF TOWN/CITY _____
REGION_____

Thank you so much for answering all these questions. I am very grateful for your time.
PROCEED TO INCENTIVE PROCESS.

~END OF SURVEY~

34. **CONFIRM GENDER FROM PATIENT FILE.**

☐ MALE

☐ FEMALE

DATA FROM MEDICAL RECORDS

35. **RECORD BLOOD GLUCOSE AND BLOOD PRESSURE DATA FROM TODAY'S TEST RESULTS BELOW. IF EITHER RECORD IS NOT AVAILABLE WITHIN THE FILE, CHECK WITH NURSE ON DUTY TO CONFIRM IF PARTICIPANT HAS COMPLETED TESTS. OTHERWISE, WRITE N/A WITHIN THE SPACE BELOW.**

Type of record	Value
Patient's fasting blood glucose reading	
Patient's HbA1c	
Patient's blood pressure reading (BP reading)	